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U. S. DEPARTMENT OF AGRICULTURE

A REPORT

ON THE

WORK AND EXPENDITURES OF THE
AGRICULTURAL EXPERIMENT
STATIONS

DURING THE FISCAL YEAR ENDED
JUNE 30, 1913

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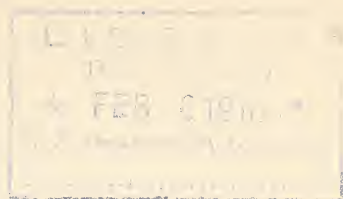
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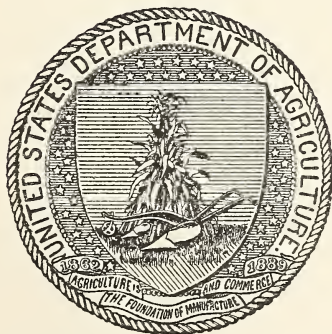




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WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1915.

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The DIRECTOR and ASSISTANT DIRECTOR.

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W. E. HESS, Expert gardener.

LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF EXPERIMENT STATIONS,
Washington, D. C., February 5, 1915.

SIR: I have the honor to transmit herewith a report on the work and expenditures of the agricultural experiment stations during the fiscal year ended June 30, 1913, as required by law. The report also contains a brief statement of the relations of the Office of Experiment Stations with the agricultural experiment stations of the several States and Territories.

Very respectfully,

A. C. TRUE, *Director.*

Hon. D. F. HOUSTON,
Secretary of Agriculture.

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WORK AND EXPENDITURES OF THE AGRICULTURAL EXPERIMENT STATIONS, 1913.

By E. W. ALLEN and J. I. SCHULTE.

RELATIONS OF THE OFFICE OF EXPERIMENT STATIONS WITH THE AGRICULTURAL EXPERIMENT STATIONS.

The relations which the Office of Experiment Stations bears to the system of agricultural experiment stations fall under two main heads—advisory and supervisory relations.

The advisory relations involve the giving of assistance in matters pertaining to the organization and conduct of station affairs, suggestions in regard to lines and features of investigation, aid in locating suitable officers and investigators, and advice on a great variety of topics which wide familiarity with conditions and special study of the subject have made possible. Through the medium of Experiment Station Record, an abstract journal prepared in the office, the progress of agricultural investigation throughout the world is made readily available to station workers and teachers, and information is given regarding the personnel, appropriations, and activities of the individual stations in this country. Statistics of the stations are also compiled annually, showing the revenues of the stations from various sources, the various classes of expenditures, and similar data, and otherwise the office serves as a clearing house and headquarters for the experiment-station system.

In its supervisory relations the office concerns itself with the conduct of the stations under the Hatch and Adams Acts, and the use made of the funds derived under these acts. In this connection account is taken of the fact that the stations are under the law State institutions, to be administered locally in accordance with the conditions and special needs of the localities. But the office has endeavored to give true direction to the station work, especially that conducted under the Federal funds, to stimulate investigation and experiment of a higher order, that results may be secured which will be safely interpreted and will endure, and to bring about conditions within the stations which are favorable to the proper and effective use of the funds contributed by the Federal Government.

The position of the stations and their relations with the local agricultural colleges and with the States make the task a far more com-

plicated one than the mere examination of the expenditures. These expenditures find their justification in the nature of the work and the provision of suitable conditions, and they are considered in direct connection with the work performed. Money paid for salaries, labor, supplies, and apparatus may be misapplied or uneconomically used unless the conditions essential to their effective employment in agricultural experimentation and research are provided. Hence the general situation at the institution, the employment of capable men for the station work, the provision of opportunity for them to carry on their investigations effectively and without undue interruption, are quite as essential considerations as the exact use to which the funds are devoted. These matters must be determined in order that the department may be in position to certify annually, in terms of the law, "as to each State and Territory whether it is complying with the provisions of the act and is entitled to receive its share of the annual appropriation * * * and the amount which thereupon each is entitled respectively to receive."

The office makes an annual inspection or examination of each station receiving Federal funds, examining its accounts and its general condition, and it approves the financial reports submitted at the end of the fiscal year by each of the stations; but in addition it maintains a close relation with the stations throughout the year, and in the case of the Adams fund passes in advance upon the projects to which the money is to be devoted.

The policy of the office toward the stations and their work remained unchanged during the fiscal year. The individuality and freedom of the stations was supported, and at the same time the necessity for proper organization and adequate provision for administrative management continued to be urged. The modern conception of the experiment station as an institution for investigation and research related to the broad subject of agriculture was maintained, but from the fact that other agencies have been provided for popular teaching, emphasis was laid on the absolute conservation of the station's funds for its legitimate work.

The relations with the stations remained uniformly harmonious and cordial throughout the year, and a thorough understanding prevailed. Common interest in the cause of agricultural experimentation and a sympathetic and appreciative attitude toward it made these relations possible.

The office is in immediate charge of the experiment stations in Alaska, Hawaii, Porto Rico, and Guam, the appropriations for which are made directly to the department. These are administered through local agents corresponding in the main to the directors of the State stations. The connection, however, is more intimate and the super-

vision as to general policy is more far-reaching than in the case of the State stations responsible to their local boards.

In addition to these functions, the office was charged with the conduct of studies in irrigation, drainage, human nutrition, and agricultural schools and farmers' institutes, carried on both independently and in cooperation with the States.

REVENUES.

The income of the Office of Experiment Stations during the fiscal year was as follows:

Appropriations by Congress:

For the general expenses of the office.....	\$96,640.00
For the Alaska experiment stations.....	30,000.00
For the Hawaii Experiment Station.....	30,000.00
For the Porto Rico Experiment Station.....	30,000.00
For the Guam Experiment Station.....	15,000.00
For investigations on agricultural schools and farmers' institutes.....	15,760.00
For nutrition investigations.....	16,000.00
For irrigation investigations.....	98,300.00
For drainage investigations.....	100,000.00

Total appropriation.....	431,700.00
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Sale of agricultural products at the insular experiment stations:

Alaska experiment stations.....	6,283.83
Hawaii Experiment Station.....	570.90
Porto Rico Experiment Station.....	1,951.62
Guam Experiment Station.....	141.60

Total from sales.....	8,947.95
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Total income.....	440,647.95
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A review of the progress of the experiment stations collectively and individually is given in the following pages:

REVIEW OF THE YEAR.

The year 1913 was a period of continued growth and prosperity for the experiment stations in this country. This applied not merely to the material resources and number of men employed by the stations, but in a marked degree to the amount and the character of the work performed. This last is the important criterion in judging of progress, but coupled with it was the steady development of confidence on the part of the public, including the farming people, the scientific world, and the industries related to agriculture; and a better understanding of the time element in investigation. The public has become more patient in awaiting the results of investigation, and has a fuller realization of the fact that answers to its problems can not be made to order at short notice.

The field of influence of the stations is steadily extending, as related industries come to see the advantages of their work. Thus agriculture and the industries resting on it are steadily progressing in the direction of a more substantial basis of scientific understanding.

One noticeable advance has been in the direction of concentration, a relieving of the stations of doing so many things, reducing the amount of teaching and of extension work expected of its men, and organizing the control activities so that the constructive work of investigation will be allowed to go on uninterrupted. The stations continue to administer numerous undertakings which are not within the scope of the Federal appropriations, in accordance with special State laws. The various inspection services, which are growing in number almost every year, are the most prominent of these, but there are in addition such other duties as the management of branch stations, the operation of hog-cholera serum plants, soil and other surveys, stallion registration, advanced registry tests for dairy breeds, extermination of pests, and a variety of other features which are not connected with teaching or extension, but are often an outgrowth of the stations' activities. Theoretically, many of these functions would seem to lie in the province of the State departments of agriculture, but they were originally assigned to the stations, and confidence in their being carried out there in a scientific and reliable manner has often prevented their being transferred.

These functions give to the stations an unusual breadth of scope, and require special provision in the organization to avoid interference with the primary duties. This is now being taken account of to a larger extent, and with other changes is yielding a greater degree of concentration than has previously existed.

The changed relations into which the stations have come through the development of extension work and its segregation from the station is one of the most important developments. In the past the experiment stations have done many things which belonged rather to extension, and because of the close contact which this gave the stations with the farming public some institutions have been slow to relinquish it and to recognize the changed conditions. In the interest of their primary work it has been strongly urged that the stations should now give up all demonstration work, supervision of field agents or advisers, preparation and distribution of compiled popular information, management of farmers' institutes, movable schools, lecture courses, etc., and this has been insisted upon as far as the use of the Federal funds was concerned. Under this plan the experiment station would be confined to the work of experimentation and research, and the publication of its results in both technical and popular form. Where substations are maintained these

should be an integral part of the station, as much as any other experimental work, regardless of where it is carried on in the State. But when any piece of work ceases to be experimental, and there is need of demonstrating it broadly to the people, it should be turned over to the extension department for that purpose.

One effect of the sharper differentiation of duties has been shown in the tendency to secure a staff more largely concerned with the station work, and whose other duties are at least minimized. Theoretically it may be maintained that men occupied largely with teaching or similar work can with advantage take part in the station work—at least should be conducting some investigation. It is an unmistakable advantage to teachers in broadening their view and giving freshness to their work, and some benefit may accrue to the stations also. But it is very clear at this stage that if a station is to carry on its work actively and profitably as a search for truth it must have a considerable staff whose time can be depended on and with whom the station work is the main thing. The station's activities must be systematic and continuous, and they should not be contingent upon other functions of the college. There is steady progress in the recognition of this principle.

The demand for men has also become more exacting. This has been accentuated by the sharper differentiation, and the transfer of the extension functions to a separate department and corps of workers. The demand now is for a higher grade of men of adequate training and with capacity for thoroughgoing research. The need of such men is keenly felt. It is a mark of progress.

As the stations' investigations become more fundamental and searching, the problems they deal with, as well as the elaboration of principles, lead the investigation further and further out into the sciences. To attack these matters effectively requires ability to analyze the problems and to see their ramifications. It also requires thorough training in science, both as to method and interpretation, and the ability to establish a hypothesis. In other words, it requires as high order of training and research ability as any line of inquiry, and the exceptional man can find free scope for his talent. The right accumulation of data is no more important than its proper interpretation, and, as data are accumulated as a means to an end, the purpose must be clear and the means employed such as to serve the end.

The station work has profited by the increasing avenues which are developing for its dissemination and means for making it effective in practice. The larger provision for extension teaching has been a great aid to that end. The interests of both the station and the extension departments will call for close union and cooperation,

in order that each may take full advantage of what the other organization has to offer and the public receive the full benefit.

In spite of the generally favorable conditions, in several States conditions remained unsettled, to the detriment of the station's work and its usefulness as a public institution. In such cases effort was made to bring about greater stability and to protect the station workers and the Federal funds, and where changes in personnel were made it was insisted that men of suitable qualifications should be appointed. In this the efforts were usually measurably successful, although temporary suspension of funds was in some cases necessary and in others disallowance of funds which were deemed misapplied under the Federal laws.

The position has been taken that efficient station work demands an atmosphere of fairness and justice, and reasonable security to the staff. It furthermore requires stability with policy, and the highest possible measure of continuity in work and in personnel. Money spent on discontinued or interrupted projects is usually very largely wasted. The director of the station, as the guiding head, is mainly responsible for the success of the station. A good station and a good director generally go together. Considering the importance of his position, the station director deserves to be sustained and supported by the board in carrying out the general policy after it is approved. A change in the director is inevitably a temporary shock to the work, often interrupts projects, causes changes in the policy and personnel, and creates an era of uncertainty; hence a change is not justified, except when clearly indicated by incompetence or inability. The same applies to heads of important divisions, whose investigation is a part of their personality.

In the discharge of its functions in administering the Federal funds and in seeing that they are properly used, the department can not fail to take cognizance of so important and vital a matter as violent changes in the director or staff of a station, which at once raise questions of policy and of conditions inimical to the station. Fortunately such action is now rare. In one State the director was summarily removed, without just cause, creating much unrest in the staff and leading to the voluntary resignation of several members. The action led the department to record its disapproval and to insist upon the restoration of stable conditions before further funds were certified. In several other instances the conditions have resulted in changes in the working force, in the effort to find more favorable surroundings; and in others the department has been obliged to remonstrate against the appointment of incompetent persons.

In the main, however, the conditions essential to station work have been realized and have prevailed to a larger extent than for-

merly. An important result has been a better understanding of the stations among scientific men and the ability to attract and retain strong men in the station work. Only by making the field an attractive one and insuring opportunity for continuous work can the kind of persons be secured which the work requires, and their best efforts be developed. Each year has noted marked progress in the direction of permanency and security, until a point has been reached where a disregard of these requirements receives the general condemnation of the stations as a whole, and is promptly reflected in the difficulty of enlisting qualified men.

A notable improvement in station management occurred in Georgia. The office had made repeated objection to the kind of work for which the Federal funds were being used and to the lack of favorable conditions and support for scientific work. In connection with a change of director a man of training for such work was appointed, provision was made for increasing the scientific staff of the station and reducing the general farming operations, and conditions generally were materially improved for scientific work. The whole atmosphere and spirit of the institution changed. Agitation looking to the removal of the station to the college of agriculture, where it would share in the ample provision made for agricultural work and be in closer connection with the teaching and extension activities was viewed more largely from the standpoint of the station's interests; and while the change was not authorized by the legislature, a definite determination was reached by those in authority to maintain the station on a higher scale of efficiency as long as it remained in its present isolated location. An earnest effort was made to secure a small State appropriation for the station, which, although unsuccessful, is being continued. The difficulty of attempting to operate an experiment station away from an agricultural college without ample State funds to supplement the Federal appropriations was forcibly illustrated in this case.

There was a strengthening of the station organization in a considerable number of instances, with more adequate provision for administration. The last remaining instances in which the president of the college served also as director of the station were removed by the appointment of special officers to attend to the station administration and to the general direction of its work. This has long been recognized as desirable in securing efficiency in a field of endeavor which calls not only for plans and direction but for stimulation and encouragement of the workers, and a sympathetic understanding of the needs of such work. In one instance during the year the director was placed in charge of the college also, but this was not understood to be a permanent arrangement.

PUBLICATIONS.

The number and volume of the station publications decreased somewhat during the year, due to a sharper distinction being observed between these publications and those of the extension division. The decrease in compiled bulletins and the exclusion of many popular extension publications formerly carried in the station series was quite noticeable. The effect of this will be to give distinction to the station publications as records of investigation and of results accomplished.

This segregation of the general information bulletins and circulars does not mean that the stations will not issue popular accounts of their work, but rather that they will not continue to compile general information and advice from current sources. It is as advisable as ever that they should prepare accounts of their work in form for popular consumption, and should be given credit for what they contribute of practical application and interest. These contributions may be in newspaper accounts, circulars, or bulletins, but they should relate to new findings by the station and thus be distinguished from the compilations and write ups issued for the use of the extension department.

The number of technical bulletins has steadily increased. Several of the stations have added technical series, to accommodate reports of investigation too technical to be given general circulation. This has placed them in a series where they will not be misunderstood and will be given such distribution as their character warrants.

ADAMS FUND WORK.

Much care was devoted to the projects conducted under this fund. Plans for the use of the fund are submitted at the beginning of each year, and new projects are outlined in advance, which are examined and passed upon. The object is to secure a thorough understanding of the contemplated work before funds are expended upon it and to insure their restriction to investigation and research. In some cases, where the character of the work was otherwise acceptable, objection was raised to it on the ground of insufficient support, the station already having as large a list of projects as could be supported with the funds at hand. Adequate support is quite as essential to the development of real research as is the formulation of the project and the method of procedure, for without proper support to meet its reasonable needs the progress must be slow and halting and the efficiency of the study be materially interfered with. This tendency has been abundantly illustrated in the past and has led the office to scrutinize carefully each new undertaking in the light of its support. With a definite amount of money available for

research each year, it is felt that a program should be made up which will fully recognize the needs of the lines of work already stated and will protect each project from encroachment on the funds necessary to its proper execution.

The holding of the investigations under this fund to the standards represented by the projects as originally agreed upon has required constant watchfulness. Less difficulty is had in securing suitable outlines, but there is a tendency among some workers to lay stress on the simpler features of a project in its execution, omitting to a considerable extent the features which give the undertaking its research character. And, furthermore, there is a constant tendency to develop side lines which lead far away from the original thesis and often have the effect of scattering the effort instead of concentration upon a definite problem or feature.

These difficulties would be more largely controlled by closer administrative attention to the course of the investigations and their trend. This is clearly a part of good administration. Although the director can not be expected to be a leader of research in its various lines, he may reasonably be expected to keep himself in close contact with the work by some means and to exercise a check upon vacillation or unwarranted departures from the project.

INCREASE IN FUNDS AND EQUIPMENT.

The Federal appropriations for experiment stations, including those for the insular stations, for the fiscal year ended June 30, 1913, amounted to \$1,545,000. Additional financial aid during the year was rendered by State appropriations aggregating \$1,807,016.51, an increase over the previous year of \$314,218.39. The revenues were also supplemented by a sum of \$1,407,502.26 derived from fees, contributions, the sales of farm products, and some other sources. The total revenue of the stations during the year was \$4,759,518.77, an increase over the previous year of \$586,278.68.

It is interesting to note the steady growth of the State station revenues. The funds appropriated under the Adams Act reached their maximum (\$15,000) a year in 1911. In that year the total resources of the stations amounted in round numbers to \$3,662,425. Of this amount \$1,246,470 came from State appropriations and \$1,440,000 from the Federal Treasury, the direct State appropriations nearly equaling the Federal appropriations. In 1912 the total revenue had increased \$400,000, amounting to \$4,068,240, and the direct State appropriation exceeded the Federal appropriation by about \$50,000. Further increases in revenues other than the Federal funds were shown in 1913, as noted above, the direct State appropriation exceeding the Federal funds by nearly \$350,000.

Although the Hatch and Adams Acts contain no direct requirement of State appropriations, this is implied in the restriction of the amount which may be used for buildings, and more directly in the wording of the opening clause of the Hatch Act which describes the measure as an effort "to aid" in acquiring and diffusing information through experiment stations. The passage of the Adams Act in 1906 was a pronounced stimulus to State appropriation. For several years previous to its coming the total funds provided by the States averaged about \$500,000 annually. The year the act was passed the State appropriation jumped to nearly \$710,000, and increased steadily year by year until in 1913 it amounted to fully \$1,000,000 more than when the act was passed. The increase in the annual State appropriation for the stations from 1906 to 1913 exceeded the Adams fund appropriation by more than \$350,000. This is a gratifying showing of interest on the part of the States, and proves their readiness to cooperate fully with the General Government in the support of these institutions.

Unfortunately State appropriations have not been enjoyed by all of the stations, although all receive some revenues in addition to the Federal appropriations. In at least 15 States no direct State appropriation as such was made, but in several of these the stations shared in certain State revenues, thus receiving the direct benefit of State aid. The great necessity for State support is more apparent each year. The Federal funds are quite strictly limited and without other revenues it is very difficult for the stations to reach their full usefulness.

Among the increases in State funds and equipment during the year the following are of interest:

The State of Arizona appropriated \$165,000 for an agricultural building, the benefits of which will be shared largely by the station.

A new building was completed for the Citrus station, Riverside, Cal., at a cost of \$25,000.

A new hydraulic laboratory, costing \$10,000, and for use primarily in testing and calibrating devices for measuring water for irrigation, was constructed at the Colorado Experiment Station. This laboratory is equipped and maintained under a cooperative agreement by the Colorado Agricultural College and Experiment Station and this department.

The annual State appropriation of the Connecticut State station at New Haven was increased to \$8,500, including \$1,000 for the State entomologist, who is also entomologist of the station.

For the biennium including the past year the Florida station had State allowances of \$4,000 for equipments and betterments, \$3,000 for a new dairy building, and \$3,000 for publications.

The State appropriations for the Idaho station include \$3,000 for the poultry department, \$4,000 for the animal husbandry department,

\$5,000 for investigations in orchard irrigation, and \$4,000 for the study and control of the alfalfa weevil, which has become troublesome in the State.

New greenhouses and service buildings, costing about \$87,000, were erected during the year at the Illinois Experiment Station.

The Indiana station toward the close of the year completed a new dairy building which provides office and laboratory room as well as creamery equipment.

The Iowa station had an appropriation of \$55,000 for the past year, and the State legislature enacted a law providing a tax levy of one-half mill for the further equipment and support of the agricultural college and station. This act allows \$40,000 for maintenance of the station, \$10,000 for veterinary investigations, and \$17,000 for the purchase of an experiment farm, with an additional \$2,500 for its equipment.

The State of Kansas appropriated \$68,000 for the experiment station and for the maintenance of the substations.

The Kentucky station erected a building at a cost of \$5,000 for the breeding and rearing of guinea pigs, rabbits, mice, and other laboratory animals which enter so largely into its research work.

The State of Louisiana purchased a tract of 60 acres for the use of the station at Baton Rouge adjacent to its present holdings. A new residence costing \$3,500 was built at the Rice Experiment Station at Crowley.

The Maine Legislature granted for the use of the station \$5,000 per annum for animal husbandry investigations and \$10,000 for the purchase of a farm in Aroostook County, to be under the control of the station for plant breeding and other investigations.

A new dairy building was constructed by the Michigan station at a cost of nearly \$50,000. The State appropriated \$5,000 for station publications.

The general State appropriations for the Minnesota Experiment Station were increased approximately \$40,000, not including increases for repairs and alterations and the allowances for extension work.

The State of Missouri appropriated \$30,000 for the maintenance of the station, \$20,000 for soil-test fields, \$12,000 for work in animal husbandry, \$5,000 for work in dairy husbandry, \$6,000 for the purchase of pure-bred stock, \$3,000 for horticulture, \$10,000 for agricultural laboratories, \$2,000 for farm-management investigations, and \$15,000 for equipment, additions to barns and greenhouses, rent of land, etc. A chemical laboratory costing \$60,000, to be devoted mainly to agricultural chemistry, was constructed at the college and station.

The State of Montana established a grain laboratory at the station, allowing \$2,000 for its equipment and \$2,000 a year for its maintenance.

The State appropriations for Cornell University included grants of \$91,000 for an animal husbandry laboratory building, \$15,000 for the equipment of the poultry husbandry building, and \$2,000 for investigations of the diseases of the gladioli and other bulbous plants.

South Dakota appropriated \$10,000 for the further collection and introduction of Siberian alfalfas and \$15,000 for the propagation and distribution of hardy strains for the semiarid regions of the State.

The board of trustees of the Washington Agricultural College authorized the construction of a building to cost \$150,000 for use jointly by the experiment station and the divisions of agriculture, horticulture, and extension work of the college. The station also had a State appropriation of \$5,000 for the year.

The West Virginia station received from the State \$10,000 for the promotion of horticulture, \$4,500 for animal husbandry investigations, \$2,500 for work on tobacco, and \$4,500 for the printing of station publications.

The University of Wyoming is constructing an agricultural building at a cost of \$100,000, which is to include the laboratories and offices of the experiment station.

CHANGES IN PERSONNEL.

Changes in the membership of the staffs, affecting over 300 positions at the experiment stations, took place or were arranged for during the year. These changes included appointments, resignations, transfers, and fortunately only a few deaths.

In the directorship alone changes occurred at 11 stations. The appointment of I. D. Cardiff as director of the Washington station to succeed R. W. Thatcher, placed in charge of the division of chemistry of the Minnesota station, and the resignation of C. F. Adams as director of the Arkansas station, of M. V. Calvin as director of the Georgia station, and of L. H. Bailey of the Cornell University Experiment Station at the close of the year should be mentioned in addition to similar changes already noted in the previous report. The directorship of the Arkansas station has since been filled by the appointment of M. Nelson, and the directorship of the Georgia station by the appointment of R. J. H. de Loach.

Other important changes in personnel included the appointment of H. E. Van Norman, dairy husbandman of the Pennsylvania station, as vice director of the California Experiment Station, with the additional title of professor of dairy management; and the resignation of O. A. Johannsen, entomologist of the Maine station, to go into

college work; of J. A. Jeffery, soil physicist of the Michigan Experiment Station; of R. Hoagland, chief of the division of chemistry and soils of the Minnesota station, to enter upon work in this department; of F. J. Alway, chemist of the Nebraska station, to take charge of the division of soils of the Minnesota station; of C. Brooks, botanist, B. S. Pickett, horticulturist, and T. R. Arkell, animal husbandman at the New Hampshire station, being succeeded by O. R. Butler, J. G. Gourley, and J. M. Jones, respectively; and of L. D. Swingle, parasitologist of the Wyoming station, to take up college work. In California, H. J. Webber, of Cornell University, entered upon the position of director of the Citrus Experiment Station and dean of the Graduate School of Tropical Agriculture.

At a number of institutions the work was differentiated to a greater extent by the creation of departments which necessitated the appointment of heads or chiefs and often also required the enlargement of the staffs.

SUBSTATIONS AND DEMONSTRATION FARMS.

In many States adequate provision to meet present requirements has been made in the establishment and maintenance of substations and demonstration farms. Furthermore, legislation already enacted and prospective tends to influence the field of these institutions, and this accounts to a large extent for the reduction in the number of new enterprises of this class. Some of the more important facts connected with the progress in this line during the year under discussion are here briefly mentioned.

In California an additional substation was opened at Meloland, in Imperial County, where a tract of about 40 acres was secured and buildings and water supply provided. Attention is to be given to demonstration work with fruits, grains, forage plants, cotton, and other crops. During the year the Sacramento Valley Grain Association was incorporated to provide land and equipment for a cereal station to be located near Biggs, in Butte County. This is to be a private station supported by subscriptions, and the donors will receive or may sell the surplus seed grain produced. The principal object of the venture is the development of new and more profitable crops for the Sacramento Valley.

The establishment of a series of some 12 demonstration farms of about 20 acres each was authorized in Kentucky, and arrangements were made whereby 4 of these farms, all located in the western part of the State, would be donated to the station.

In Minnesota plans were approved for a dairy laboratory at the north central farm at Grand Rapids, and arrangements were entered into by which the Cloquet substation is to be maintained

on a cooperative basis with this department. Considerable increases in funds for buildings and maintenance were also secured for the substations in the State.

A substation was established in Virginia at Tasley for the purpose of studying the production, marketing, and use of truck crops grown in that section.

In Hawaii a small modern creamery plant was established at the Glenwood substation and about 1,000 pounds of butter per month is being made from milk received from neighboring dairymen. The Territorial legislature appropriated \$30,000 for the next biennium to enable the Federal station to develop substations on the various islands and assist in the marketing of local products. Three new substations were to be established—two on Hawaii and one on Maui—and an effort to be made to organize immediately under cooperative associations the farmers in the various parts of the Territory for the purpose of facilitating the marketing of their products.

For the ensuing biennium the Kansas Legislature granted the substation at Fort Hays \$50,000 for maintenance and \$7,500 additional as reimbursement for loss of buildings and equipment in a recent fire. The Dodge City substation was given \$5,000, that at Garden City \$10,000, and that at Tribune \$5,000. Two additional substations were authorized, one near Colby, in Thomas County, in northwestern Kansas, and the other near Lakin, in Kearney County, in the southwestern portion. In each case the counties were to provide 160 acres of land and for 1915 to duplicate any State appropriations for maintenance. The Colby substation received an initial appropriation of \$15,000, of which \$5,000 was to be expended for pumps and other irrigation equipment. The Lakin substation was given \$10,000 for buildings and equipment, and Kearney County required to expend \$7,500 within the next two years in drilling deep wells and doing other work along irrigational lines. The forestry substation at Ogallah was discontinued.

The use of the county poor farms in Wisconsin was reported as increasingly popular. An annual demonstration picnic is held at each of these farms at which the average attendance has risen from 80 in 1909 to 450 in 1912.

The Maine Legislature granted an appropriation of \$10,000 for the purchase of a farm in Aroostook County, to be under the control of the station and to be used for plant-breeding and other investigations, especially those pertaining to potato culture.

Appropriations made by the Arizona Legislature included \$30,000 for a new station farm in the Salt River Valley of that State.

SOME RESULTS OF STATION WORK.

The field of experiment station work is very broad, covering practically the whole field of agriculture and many phases of the agricultural industry. A few examples of results which have recently followed from the work are presented to give an idea of its scope and its practical bearings.

The work of the stations in agronomy is enlarging in scope from year to year, and the subject as a branch of study and field of experimentation is becoming better classified and systematized. The Wisconsin station continued to secure good results with various strains or varieties of field crops it has selected, including, among others, some pedigreed strains of Wisconsin Early Black soy beans, which ripen in 90 to 105 days on sandy soil in the northern part of the State and have given an average yield for three years of 15.4 bushels of beans per acre.

The use of orchard-heating oil as a means of eradicating wild garlic was found by the Indiana station to be effective, practical, and only moderately expensive. The oil, applied in the field by spraying early in May, showed immediate results with complete killing of the garlic, including the underground bulbs.

Experiments carried on by the Pennsylvania station with burnt lime and pulverized raw limestone gave results in favor of the latter, but only on soils acid in reaction did lime do any good. This station also found that red clover is tolerant of soil acidity up to the equivalent of 1,500 pounds of calcium oxid, expressed as the requirement per acre for the neutralization of the acidity in the upper 7 inches of soil.

The South Dakota station demonstrated the possibility of growing sugar-beet seed of the highest quality in South Dakota, and by selection increased the percentage of sugar in the beet in one strain to 25.4 per cent. The station also successfully adapted the tobacco planter to the use of setting out alfalfa plants in rows, in order to admit of their cultivation, which is largely practiced in the dry region of the State and elsewhere. At the Massachusetts station a comparison of muriate with sulphate of potash in connection with bone meal showed a decided superiority in favor of the sulphate on alfalfa, the quantity of actual potash supplied being the same. The Washington station reported an increase in yield of more than 100 per cent of dry material in alfalfa from the use of 200 pounds of gypsum per acre.

The results of investigations in the feeding of farm animals have indicated not only more profitable methods of marketing forage, but have also pointed out the wider use of certain crops in feeding and the more accurate application of scientific principles in animal husbandry. At the Idaho station alfalfa hay marketed through the fattening of average range lambs returned a farm value of from \$9 to \$15 per ton.

The Missouri station secured data giving a basis for applying the feeding standard more accurately to cows producing milk varying widely in fat content; while results of feeding studies with steers indicated that, under the conditions of the experiment, and estimated on the basis of net profit per steer, a ton of dry matter in the form of corn silage yielded 50.3 per cent greater value than a ton of dry matter in the form of shocked corn. The Florida station reported satisfactory results in the ensiling and use of sweet potatoes and cassava for feed. The West Virginia station showed that fowls fed poorly balanced or abnormal rations lay eggs low in weight.

Valuable results were also secured along the lines of milk production and dairy manufacture. A study on the cost of milk production in Massachusetts by the Massachusetts station showed that it cost substantially $5\frac{1}{2}$ cents a quart to produce milk of a proper standard of cleanliness and testing substantially 5 per cent of fat. The Idaho station secured results showing that the amount of acid present in the cream at the time of churning is the principal controlling factor in the deterioration of butter in storage, and that this is not due to the action of bacteria, yeasts, or molds developing in the butter subsequent to its manufacture. The Wisconsin station worked out methods of making Cheddar and brick cheese from pasteurized milk, with results showing higher quality as well as a gain in the yield of cheese.

Along veterinary lines the North Dakota station established the importance of nonclinical infection carriers as factors in the maintenance of swamp-fever infection foci, and demonstrated the tenacity of swamp-fever virus in infection carriers. The Rhode Island station in further pursuing its fowl-cholera studies demonstrated the transformation of an inherited acquired immunity in rabbits into a permanent, active immunity, and discovered a culture possessing a protective action against a number of virulent fowl-cholera cultures. The studies of bacillary white diarrhea in progress at the Connecticut Storrs station have proved that the period of great danger of infection from without is the first three days after hatching or the first four or five days if vitality of the chicks is low. The feeding of sour milk as a means of reducing loss through the disease was well demonstrated.

The etiological factor causing contagious abortion in cows, *Bacillus abortus* Bang, was isolated by the Kentucky station from three herds affected with the disease, and a biological test was devised whereby contagious abortion in cows may be accurately diagnosed. The organism causing this disease in mares was also isolated by the station and identified as different from the microorganism causing the disease in cows. The efficacy of methylene blue in killing the organism was demonstrated by the Vermont station, and a course of treatment for controlling the disease worked out.

Nitrate studies made by the Montana station indicated that where alfalfa and brome grass were grown, the nitrate content was low at all seasons. Chemical studies by the Iowa station pointed out that lactic acid is normally present in silage in excess of the volatile acids, the average ratio found being 1.0 to 0.75.

In studying the availability of phosphates the Wisconsin station determined that, contrary to the general belief that aluminum and iron phosphates are relatively unavailable to plants, many of the common field crops made better growth on aluminum phosphate than on calcium phosphate and some better growth on iron phosphate of the ferric form. The results are taken as showing the inadequacy of chemical solvents in measuring the availability of different phosphates. This station also found that such plants as June grass and red clover contain volatile sulphur compounds, and also that with an adequate supply of sulphates in the soil an abundance of sulphates was produced in the plant juice and maximum growth was attained.

The Iowa station demonstrated that frozen soils possess a nitrogen-fixing power which increases with the continuance of the frozen period, being independent of moderate changes in the moisture conditions, but restricted by large decreases in moisture. It is explained that in the fall, when the soil gradually cools, its nitrogen-fixing power increases until the soil becomes frozen, when it almost ceases, after which a smaller nitrogen-fixing power is established. It was also shown that the application of lime up to 3 tons per acre increased the ammonifying, nitrifying, and nitrogen-fixing powers of the soil and gave a proportionately greater increase than 2 tons. Lime up to 3 tons per acre increased the total number of bacteria which develop on modified synthetic agar plates.

In studies involving the relation between soil bacteria and the growth of various crops by the Wisconsin station, it was found that when pure cultures of various kinds of soil bacteria were grown in extracts from marsh soil which had previously produced corn, oats, or clover, the bacterial development in all cases was increased, the stimulation being greatest after corn, thus indicating the possibility that the growth of a given crop may favor the multiplication of certain kinds of bacteria affecting the growth of subsequent crops.

The entomological work of the stations included a study of wireworms by the South Carolina station, showing that if the moisture content of the soil falls below 30 per cent the larvæ can not live, and that the adult weevils require loose soil for oviposition, which takes place in June and July, making it possible to apply these facts in the control of the pests. In studying the spotted-fever tick the Montana station ascertained that the adult had a much longer period of life than was anticipated.

Work at the Minnesota station on physiological races and the nature of resistance in plants showed that the resistance offered by a wheat to the attacks of *Puccinia graminis* appears to be of the same nature as that offered by a given cereal to an uncongenial biologic form. Resistance was apparently further due not to morphological but to physiological causes, and was found to vary somewhat with the metabolism of the host.

Investigations in farm management were pursued by a number of these institutions, and such work at the Missouri station indicated that in the particular field of study about 17 per cent of man labor on the farm went to maintenance, 28 per cent to crop production, and 56 per cent to other production, while horse labor varied from 6 to 21 per cent for maintenance, 51 to 69 per cent for crop production, and 19 to 41 per cent for other production. The Wisconsin station, in cooperation with this department, determined that the manure produced does not pay for the labor required in managing a dairy herd, but in the case of steers and young stock the manure more than offsets labor, according to the figures secured.

INSPECTION OF THE STATIONS.

In accordance with the usual practice of the office, a personal inspection was made during the year of the work, expenditures, and general condition of each of the experiment stations receiving Federal funds. This inspection served as the means of securing a large amount of first-hand information in regard to the progress of the stations and their relations to the colleges with which they are connected and to the agriculture of the States, and the opportunity was embraced for conferences with the station officers in regard to station organization and administration. This inspection was participated in by four members of the office force—the director (A. C. True), assistant director (E. W. Allen), W. H. Beal, and Walter H. Evans.

The following reports upon the several stations are based on the results of this inspection, together with the annual financial statements of the stations, rendered on schedules prescribed by the Secretary of Agriculture and the printed and other reports received from the station officers:

ALABAMA.

Agricultural Experiment Station of the Alabama Polytechnic Institute,
Auburn.

J. F. DUGGAR, M. S., *Director*.

During the year the Alabama station carried on as its principal lines of work breeding experiments with cotton, corn and oats, miscellaneous tests with field crops, feeding trials with hogs and beef

cattle, studies of insects and insecticides, and investigations of plant and animal diseases and of poisonous plants. Work provided for by the State included cooperative experiments with field crops in every county, and analyses in connection with the fertilizer control.

The Adams fund investigations were continued and progress is reported. Additional data regarding the life history of the rice weevil were secured and practical means of control were worked out. In granaries and mills heating to 120° to 150° F. destroyed the insects and their eggs without injuring the germination of the grain. In the study of the effect of different rations on the quality of pork and lard it was found that the various leguminous forage plants and grains softened the lard, while corn and cottonseed products hardened it. The age of pigs and the percentage of protein in the ration did not seem to influence the consistency of the lard.

The work supported from Hatch and other funds included, among other lines, a study of the black spot of roses, in which the summer and winter stages of the causative fungus were worked out and the susceptibility of different varieties was noted. The different stages of the cattle tick in pastures and on the host in the locality of the station were determined, together with methods of control. The results of studies of the cotton worm indicated that a light dusting of powdered lead arsenate over the cotton plants is an effective remedy. A yield of 3,493 pounds of hay per acre from bur clover alone and of 5,520 pounds from bur clover with crimson clover and oats was reported. Chemical analysis of the bur-clover hay showed a crude protein content of 19.50 per cent.

Experiments in winter feeding of pregnant ewes pointed out that a ration made of a mixture of corn silage and cottonseed meal was better and cheaper than one consisting of cottonseed meal and hulls. Sorghum hay or mixed hay of soy beans, cowpeas, and crab grass, each fed by itself, did not maintain normal health and weight. Feeding corn and skimmed milk to hogs in a series of tests gave profitable results in each case.

Bulletins 163 to 170 and 172, Circulars 5 to 7 (revised), 14, part 2, and 16 to 20, and the Annual Report for 1912 were received from this station during the year.

The State aid received by the Alabama station is reflected in the greater scope of the station work and the wider application of its results.

Tuskegee Agricultural Experiment Station, Tuskegee Institute.

G. W. CARVER, M. Agr., *Director.*

The Tuskegee station during the past year conducted experiments in preparing compost from muck, forest leaves, and farm manures and comparing its efficiency with commercial fertilizers. The use of the

compost increased the resistance of the land to drought and excessive heat and improved the physical condition of the soil. Tests with alfalfa were continued to demonstrate the value of the crop for that section. The Provence variety showed exceptional drought-resisting qualities and produced four cuttings a season. Other lines of work in progress included experiments with the dasheen, four varieties of sorghum, and cotton and corn breeding.

The officers of the station, as customary, carried on extension work among the negro farming population mainly by giving lectures on various agricultural subjects, home economics, the improvement of roads, and on life on the farm.

Bulletins 22 to 24 of this station were received during the year.

The State appropriation for the maintenance of the station remained at \$1,500 for the year, and the work of assisting and improving agriculture in its particular field was conducted to the extent possible with the means at hand.

ALASKA.

Alaska Agricultural Experiment Stations, Sitka, Kodiak, Rampart, and Fairbanks.

C. C. GEORGESON, M. S., *Special Agent in Charge, Sitka.*

The work of the Alaska stations was continued as outlined in previous reports, with the exception of certain changes in the live-stock experiments necessitated by the eruption of Mount Katmai near the close of the preceding year. At the Sitka station horticultural investigations continued to hold precedence, while at Fairbanks and Rampart work in agronomy received the greater amount of attention.

Experiments with small fruits at Sitka included tests on an extensive scale of the hybrid strawberries originated by the station. A very effective demonstration was made of the value of the native crabapple as a stock for grafting improved varieties. The past season a larger number of apple trees bloomed and set fruit in the trial orchard than ever before, and it is believed that some of the early varieties may prove adapted to the region. About 60 varieties of potatoes were tested and several were found to produce large yields and tubers of good quality. A large number of currant, raspberry, and gooseberry bushes, as well as some grafted apple trees, were distributed to settlers upon application.

At the Rampart station most of the cereals matured in 1912. The work of hybridizing grains was continued and four varieties of beardless barley produced in this connection fully ripened by the end of August. Hybridizing and pedigree breeding of oats and wheat and a number of strains of alfalfa, introduced from Minnesota, South Dakota, and elsewhere, were also carried on. The strains of alfalfa have now withstood three winters and some, especially the

Grimm variety, have made splendid growth. Attention is now given to the production of alfalfa seed.

A most successful season was reported by the Fairbanks station. Practically all cereals ripened their entire crop and spring wheat, winter rye, barley, and oats produced large yields. A small thrashing machine, the first to be used in Alaska, was purchased by the station. More than 30 tons of oat and barley hay were cut from 22 acres, and on slightly more than 5 acres nearly 1,200 bushels of marketable potatoes and about 160 bushels of small tubers were secured.

Following the eruption of Mount Katmai in June, 1912, the Galloway cattle were removed from the reservation on Kodiak Island, the grades and old animals being sold and the remainder being taken to the State of Washington for pasturing and wintering. Preliminary experiments showed that the covering of volcanic ash caused by the eruption contained no deleterious substances and that when mixed with soil or fertilizer produced good crops. Early in the spring of 1913, 30 tons of lime nitrogen and about 5 tons of oats and grass seed of various kinds were used to reseed areas where the native grasses were too deeply covered to come through the ash. As soon as sufficient pasture and forage is provided the cattle will be returned to Kodiak.

The only publication of the station for 1913 was the Annual Report.

ARIZONA.

Agricultural Experiment Station of the University of Arizona, Tucson.

R. H. FORBES, M. S., *Director.*

The principal studies carried on by the Arizona station during the fiscal year included cultural work with cacti, investigations of date ripening and marketing, working out methods for determining alkali salts in soils, breeding operations with Tunis and range sheep, location and utilization of underground water supplies, observations on dry-farming practices, plant breeding with alfalfa, beans, wheat, and corn, and entomological investigations, mainly of the codling moth and the woolly aphis.

The Adams fund projects of the station were actively pursued and some of the studies were being completed. The investigation of the effects of copper compounds on crops determined and demonstrated the toxicity of these substances and court decisions have since been based on these results. In alfalfa-breeding work it was found that one of the strains studied transpired about 3 acre-inches of water in the production of 1 to 1½ tons of hay. Studies of the native beans revealed a new species, which was described. In breeding experiments the white variety of these beans produced a number of variations indicating that it is made up of a number of

types. A study of the chemical character and content of the oil of olive varieties grown in the locality showed a considerable difference in constituents, stearin content, solidifying point, and other similar factors.

A good deal of the Hatch fund work was done at the outlying stations, particularly at Phoenix, where one of the lines was sheep breeding, continuing the effort to obtain desirable wool and mutton strains capable of withstanding the heat. The usefulness of the sheep in keeping down Johnson grass and other growths on irrigation ditches was demonstrated, a flock of 150 keeping 5 miles of ditch in clean condition. The work at the Tempe date orchard was continued with 124 varieties and several seedlings, and a yield of 500 pounds of dates from one tree was recorded. By plant-breeding methods the station isolated a hardy sweet corn from its mixture with native maize.

For the biennium 1913-1915 the State made the following appropriations: Dry-farming work, \$18,000; farmers' institutes, \$8,800; date - palm investigations, \$10,000; horticultural investigations, \$5,000; underflow studies, \$2,500; plant breeding and plant introduction, \$4,000; publications, \$4,500; clerical service, \$5,000; a new farm in the Salt River Valley, \$30,000; and a new agricultural building, \$165,000.

Bulletins 67 to 69 and the Annual Reports for 1911 and 1912 were issued by this station during the year.

The Arizona station is doing a great amount of work for the agriculture of the State, with many of its activities on a substantial basis, and is thoroughly alive to the various needs of the different localities.

ARKANSAS.

Arkansas Agricultural Experiment Station, Fayetteville.

MARTIN NELSON, M. S., *Director.*

The Arkansas station during the past year gave consideration mainly to work on hog cholera and swine plague, diseases of orchard fruits, particularly the apple and the pear, the loss of soil fertility in fruit growing, cotton breeding, the relation of apple stocks to immunity from woolly aphis, life history and control studies of the apple tree and peach tree borers, fertilizer and rotation tests with field crops, and culture and fertilizer trials with orchard and small fruits, nuts (including the pecan), ozier willows, and vegetable crops. Hog cholera and cattle tick control work and the enforcement of the nursery and orchard inspection law were supported by State funds.

Among the Adams fund investigations the study of the apple-blight organism was completed and the results were reported. The

investigation of an unknown apple disease seemed to indicate that the trouble is of a physiological nature and is possibly due to an abnormal lenticel development. From work on pear blight it was considered that three strains of the organism had been found. Further results secured in the study of swine diseases confirmed previous findings of motile intracorpuseular bodies in the blood of both normal hogs and those having cholera and swine plague, but the bodies were much more abundant in the diseased than in the normal hogs. It is reported that in shed blood the virus appears to escape from the corpuscles into the surrounding fluid, either with or without hemolysis.

Under the Hatch fund the entomologist conducted work on the control of the apple and peach tree borers, finding asphaltum most satisfactory for protection. Experiments carried on by the horticulturist showed that apple trees may be sprayed with a strong lime-sulphur mixture, $4\frac{1}{2}^{\circ}$ Baumé, at the time of the first spraying for scab or during the latter part of April in that locality. The injury to peach leaves caused by lime sulphur was observed to be distinct from that due to the use of arsenicals and the attacks of fungi. The best nozzle for Arkansas conditions, as shown in this work, was one with an eddy chamber three-fourths inch in diameter and one-eighth inch deep and with a disk having a hole five sixty-fourths inch in diameter.

Toward the close of the year C. F. Adams resigned the directorship of the station and M. Nelson was appointed to the position. The last legislature made the following appropriations for the biennium: \$7,500 for extension in agriculture, \$2,000 for veterinary science, \$2,000 for animal husbandry, \$500 for agricultural chemistry, \$500 for plant pathology, \$1,000 for agronomy, \$2,000 for bacteriology, \$1,000 for entomology, and \$6,000 for horticulture, in addition to \$6,000 for the two branch stations.

Bulletin 111 and Circulars 15 and 16 were received from this station during the year.

The Arkansas station has recently passed through a critical period, but with a reorganization of its forces a vigorous upbuilding of the station is looked for, and the support now given by the State assures a good financial basis.

CALIFORNIA.

Agricultural Experiment Station of the University of California, Berkeley.

T. F. HUNT, D. Agr., D. Sc., *Director*.

The principal lines of work receiving attention by the California station during the past year were studies for the control of hog cholera and bovine tuberculosis, chemical and biological studies with

reference to soil fertility, experiments with cereals and general field crops, together with rotation and variety tests, feeding experiments with hogs, poultry feeding and incubation experiments, investigations of variation and heredity in plants, including studies of Nicotiana hybrids, viticultural work on pruning, grafting, and other forms of vineyard management, grape and wine handling, and studies of a number of plant diseases. Work with citrus fruits included studies of diseases, tests of fertilizers and methods of cultivation, and irrigation experiments with varieties and stocks, breeding for improvement, and observations on frost injury and its prevention. Under State funds the station also carried on the work of fertilizer and insect control.

Under the Adams fund studies were concentrated on a number of different problems. In connection with the investigations of bovine tuberculosis some immunity was produced by the use of bovovaccine, but this immunity did not remain to any appreciable extent after the third year. Among other results obtained in the chemical and biological studies with reference to soil fertility, it was found that the sulphates of copper, zinc, magnesium, lead, and iron in quantities up to 1,000 parts per million of soil stimulated bacterial life and did not give toxic effects until considerably higher amounts were applied.

Many lines of experimental work were conducted with Hatch and other funds at the station and in different parts of the State. Irrigation studies in cooperation with this office with different crops showed, among other things, that 750 pounds of water were used by alfalfa in the production of 1 pound of dry matter. In trials with varieties and improved strains of barley an average yield of 90 bushels per acre was secured without irrigation. A study of red spider and mites of citrus trees brought out the fact that each female lays about 30 eggs and that from 12 to 15 generations are produced in a year. The results of enological experiments indicated that the use of 100 milligrams of sulphur dioxide per liter had eliminated over 99.9 per cent of the active cells of microorganisms from the must and that by its proper application growth of molds and wild yeasts can be completely and advantageously prevented.

The appropriations for the station included \$1,000 for a laboratory and \$25,000 for a dwelling and barns at the Citrus station.

Bulletins 229 to 239 and Circulars 78 to 102 were received from this station during the year.

The affairs of the California station are progressive and give evidence of continued growth. The constant effort made to meet with greater efficiency the problems of the diversified agricultural interests in the different sections of the State is increasing the confidence and reliance placed in the station work by all classes of farmers.

COLORADO.

Agricultural Experiment Station, *Fort Collins.*

C. P. GILLETTE, M. S., *Director.*

The Colorado station, among other lines of work during the past year, carried on studies relating to soil nitrates as affecting the quality of sugar beets; factors causing the softening of wheat; the nitrifying and ammonifying efficiency of the Colorado soils; different phases of irrigation engineering and practice; the life history of insects, particularly of plant lice; horse breeding; diseases of poultry and horses; feeding lambs, swine, and steers; alfalfa breeding; and correlation in plants, mainly field crops.

The Adams fund work of the station was actively pursued. In the bacteriological work on soils it was found that Colorado soils had a much higher nitrifying power for ammonium sulphate and carbonate than the soil samples obtained from the humid region or than most of those secured from California. Chlorin in the soil or added as ammonium chlorid was noted to depress nitrification. A relation between the nitrates and the brown color of the soil was established, and it was found that the color was produced by *Azotobacter* in the presence of nitrates. The life history of the organism causing raspberry yellows was completed and the control of the disease by the use of Bordeaux mixture was demonstrated. Incidental to the irrigation projects, different methods of measuring water were worked out.

Experimental work under the Hatch fund was pursued by different station divisions. Studies in alfalfa-seed production indicated that the seed yields can be improved by systematic selection for the development of the character of seed production in the desired types. Under dry-farming methods from 8 to 10 bushels of alfalfa seed per acre were secured. Results further indicated that the northern types of alfalfa which put out branching stems below the surface have a stoloniferous habit which gives hardness to drought and cold. Preliminary counts and computations in variation studies of brome grass seem to indicate that there may be a relation between the tillering habit and the development which actually takes place in the pure-line strains and their progeny.

The station failed to realize on the State appropriations and was greatly hampered in its work. As a result several lines of study had to be abandoned. A special laboratory for irrigation investigations which affords exceptional opportunity for the study of problems in the flow of water, water measurement, and other irrigation subjects was completed and made available for use.

Bulletins 182 to 185 and the Annual Report for 1912 were received from this office during the year.

The Colorado station, owing to the fact that State funds did not become available, restricted its work to a few lines which were vigorously pursued. Good progress was made in the work undertaken, but the fact that consideration to all agricultural interests of the State could not be given by the station continues to point to the need of definite financial support in addition to the Federal funds.

CONNECTICUT.

The Connecticut Agricultural Experiment Station, New Haven.

E. H. JENKINS, Ph. D., *Director.*

The activities of the Connecticut State station during the past year comprised studies of vegetable proteids; breeding work with tobacco, corn, and tomatoes; selection, culture, and propagation experiments with field and garden crops; studies of plant diseases, including the mosaic disease of tobacco; peach yellows and chestnut blight; and work on insect control, especially of the gipsy and brown-tail moths. Under State laws and appropriations the station conducted the control work regarding fertilizers, feeds, foods and drugs, and the inspection of orchards, nurseries, and nursery stock. The annual State appropriation of the station was increased by \$7,500.

Definite progress was reported on all the Adams fund projects. Further data secured in the investigation of vegetable proteids confirmed previous conclusions that when fed exclusively to small animals some proteids do not maintain body weight, others provide only maintenance rations, while a third class is capable of promoting growth. It was found that the proteids lacking in amino acids did not produce growth without the addition of casein or milk to the ration. Results in plant-breeding work showed that the F_1 generations of size crosses in tobacco were as uniform as the parents and of an intermediate value, while the F_2 generations increased in variability and the F_3 generations included individuals breeding true and others giving variabilities ranging in value from the parents to that of the F_2 generation. It was further indicated that a good quality of leaf can more generally be expected in a hybrid if both parents are of high quality than if one parent is of a good variety and the other is lacking in quality.

The work carried on under the Hatch and miscellaneous funds increased in amount and importance. Spraying experiments showed that the pseudoperonospora blight of melons was controlled by the use of fungicides. In connection with breeding work with melons it was observed that specific-gravity tests gave satisfactory indications as to the quality of the fruit. Experiments on the transmission of peach yellows indicated the possibility of transmitting the disease by the insertion of infected buds or bits of bark, but the use of pollen

from diseased trees or the application of fruit juice did not produce infection. The entomological department demonstrated that serious invasions of the gipsy moth outside of woodland can be effectively controlled by the prompt and efficient application of the usual methods of combating this pest.

Bulletins 172 to 176, the Annual Report for 1911, part 6, and the Annual Report for 1912, parts 1 to 6 were received from this station during the year.

The Connecticut State station continues to come in closer contact with the farmers of the State, and the appreciation and value of this fact is reflected in the material increase in the State funds for its support and the extension of its work.

Storrs Agricultural Experiment Station, Storrs.

E. H. JENKINS, Ph. D., *Director.*

The Connecticut Storrs Experiment Station continued its studies on poultry diseases and on natural and artificial incubation of hen's eggs, concluded the cheese investigations in cooperation with this department, and pursued work on parasitic and other insects, fermentation of silage, the bacterial flora of soils, and on methods of controlling certain vegetable diseases.

The study of bacillary white diarrhea, continued with the Adams fund, showed that the period of greatest danger of infection from without is the first two or three days after hatching, but if the vitality of the chicks is low, infection may take place the fourth or fifth day. The data secured seemed to indicate further that mature hens may be infected through contact with diseased hens and their droppings or through infected litter. A study of the ovaries of hens proved their infection with *Bacillus pullorum*, and thus indicated the infection of the eggs. The feeding of sour milk proved very effective in controlling epidemics of the disease. Results obtained in the study of carbon dioxid production in incubation did not indicate that an excessive quantity of carbon dioxid in incubators is beneficial. Among other data, it was determined in the cheese investigations that the proportion of volatile insoluble fatty acids split off from the fat during ripening and imparting the peculiar flavor to Roquefort cheese is larger in sheep's than in cow's milk.

Several lines of work were conducted with Hatch and other funds. Results secured in spraying experiments showed that Bordeaux mixture, although proving most effective as compared with the different fungicides applied, did not completely control the common diseases of cucumbers and melons. It also proved injurious to the foliage of these plants, interfering in this way with the proper setting of the cucumbers and the timely ripening of the melons. A study inaugu-

rated to determine the poisonous quality of rose chafers when fed to chickens showed that a filtered water extract made from these insects proved poisonous, while an alcohol extract gave no evidence of toxicity.

The station, having been placed under the same directorship with the State station, continued its cooperation in coordinating and extending the work of the two institutions. A new poultry building, costing with its equipment about \$25,000, was in course of construction and the dairy building was remodeled and enlarged.

Bulletins 72 to 74 of this station were received during the year.

Although the work of the Connecticut Storrs station was interrupted to some extent during the year as a result of numerous changes on the staff, the principal lines of investigation were actively pursued and valuable data were secured.

DELAWARE.

The Delaware College Agricultural Experiment Station, Newark.

H. HAYWARD, M. S. Agr., *Director*.

The principal work of the Delaware station during the past year was along the lines of soil improvement by means of crop rotations, methods of fertilization, including green manuring and the use of lime, determination of returns from different systems of cropping, comparison of the effect of various carriers of phosphoric acid and of different forms of lime and lime-bearing materials, tests of varieties of wheat, potatoes, and of orchard and small fruits, fertilizer requirements of different field and garden crops, and studies of plant diseases and different phases of plant-disease problems. Extension work within the State was practically confined to cooperative experiments with farmers and carried on under a State fund of \$5,000 appropriated for the purpose.

In general satisfactory progress in the Adams fund work was reported. Data secured in connection with the project on the relation of the chemical composition of different varieties to the various plant-food elements in the soil showed that tillering is apparently a varietal characteristic and that an increase in the number of tillers per plant within a variety as well as among varieties was accompanied by a higher yield per spike. Results obtained in an investigation of the toxicity of vegetable acids and the oxidizing enzyme showed, among other things, that a number of species of *Glœosporium* and *Colletotrichum* will cause more or less typical bitter rot on the apple and will cause characteristic anthracnose wilt of the sweet pea. For work on the chemistry of fruit sugars, an apparatus was devised for polarization at high temperature.

In addition to the Adams fund projects, extensive experiments were conducted with fertilizers and cover crops for orchards, and with fertilizers and methods of culture for tomatoes. The results obtained indicated that a fertilizer high in potash and low in inorganic nitrogen and phosphoric acid is best for peaches, that the peach buds are hardiest with a cover crop of oats, and that root crops are not well adapted as orchard cover crops. It was found that a fertilizer containing 3 to 5 per cent of quickly available nitrogen, 5 to 7 per cent phosphoric acid, and 8 to 10 per cent potash was best for tomatoes, and that crimson clover is an excellent cover crop for use between crops of tomatoes. In a study of tomato culture for canning purposes it was observed that the time required to ripen 50 per cent of the crop is an important factor in choosing varieties. The varieties under test ripened 50 per cent of the crop on an average in about 15 days after the first fruits began to mature, the minimum and maximum period being 10 and 19 days, respectively.

During the period covering this report the station entered upon the construction of a greenhouse provided for by State appropriation and made some minor improvements in the buildings and equipment of the station farm.

Bulletins 96 to 98 were received from this station during the year.

The work of the Delaware station is progressive to the limit of the funds at its disposal and is having a marked effect on the improvement of farm practice within the State.

FLORIDA.

Agricultural Experiment Station of Florida, Gainesville.

P. H. ROLFS, M. S., *Director.*

The Florida station the past year conducted work principally on soil types and fertility in relation to plant growth, citrus and vegetable diseases, control of the white fly and other insects, plant nutrition as related to diseases, mainly die-back and the gumming of citrus trees, plant breeding, principally with beans and corn, plant introductions, orchard management, milk and pork production, and the culture and rotation of field crops.

Progress was recorded in the Adams fund work and some of the results were reported. The investigation of citrus diseases led to the conclusion that melanose and stem-end rot are produced by the same organism, which so far has been found to produce spores only on dead wood and mummied fruits, the dead branches and twigs apparently being the principal source of infection. In the study of parasites attacking the white fly another fungus was found destructive to the insect, but this organism was less active than the brown fungus which appears to be one of its chief enemies. The study of

plant nutrition in relation to diseases demonstrated that die-back can be produced by the use of sufficient quantities of stable manure and cottonseed meal. The plant-breeding work, among other results, has given rise to two hybrids between the velvet bean and Lyon bean which appear very promising for general culture.

The work supported by the Hatch fund and other activities of the station embraced a number of different lines. Among numerous plant introductions, Rhodes grass, Sudan grass, Yokohama beans, Lyon beans, Chinese velvet beans, and other similar plants were found valuable for dissemination. In feeding experiments it was found that Japanese cane had but little value as a forage for pigs. Sweet potatoes and cassava roots were found to keep well in silage, and in this form were relished by cows and pigs. Experiments in the continuous culture of velvet beans indicated that this crop should not be grown on the same land oftener than every two or three years.

For the ensuing biennium the State appropriated \$4,000 for equipment and improvement of the station building and farm, \$3,000 for a new dairy building, and \$3,000 for publications.

Bulletins 109 to 113 and the Annual Report for 1912 were received from this station during the year.

The general conditions and organization of the Florida station are very satisfactory, and the forthcoming and much-desired aid extended by the State will provide a better financial basis and measurably favor the development of the varied station activities.

GEORGIA.

Georgia Experiment Station, *Experiment*.¹

R. J. H. DE LOACH, A. M., *Director*.

The general activities of the Georgia station included plant-breeding investigations with cotton and grapes, studies of diseases attacking cotton, plums, and tomatoes, feeding tests with different farm animals, the study of barnyard manure in relation to the bacterial flora of the soil, life-history studies of the mole cricket, which were concluded, a study of the basis of soil fertilization for cotton, orchard experiments with various fruits and nuts, the use of dynamite in subsoiling, and culture and fertilizer tests with cotton, cereals, and forage crops. Strife and upheaval within the station seriously affected the progress of its experimental work, but since the close of the year a reorganization has been effected and conditions greatly improved.

Among the Adams fund investigations, the study of the wilt of Japanese plums was concluded, the data indicating that the disease

¹ Telegraph, freight, and express address, *Griffin*.

is caused by a fungus entering the plant at points where injuries have been sustained. Work on the blossom-end rot of tomatoes showed the effect of irrigation in preventing the disease by keeping up the soil-moisture supply. It appeared that soil moisture sufficient to maintain the tip cells in a turgescient condition was required to avoid the entrance of the organism. The investigation on soil as a medium for *Pseudomonas radiculicola* showed that the organisms retained their virulence and lived longer in sterilized soil than in the ordinary culture media.

The usual variety and fertilizer tests with cotton and corn were carried on under the Hatch fund, together with some minor work in other lines. Among 16 varieties of corn Batt 4-ear ranked first, with a yield of 34.33 bushels per acre, and among 25 varieties of cotton Steinheimer Cleveland proved the heaviest producer, with a yield of 1,756 pounds of seed cotton or 640 pounds of lint per acre. In fertilizer experiments with cotton better results were secured with sulphate of ammonia as a source of nitrogen than with the use of either cottonseed meal or nitrate of soda. A test of subsoiling with dynamite was conducted at a cost per acre of \$16.80.

The erection of new barns to replace those destroyed by fire September 4, 1912, was begun.

Bulletins 99 to 102, Circular 68, and the Annual Report for 1912 were received from this station during the year.

It is to be hoped that the changes in the organization of the Georgia station will so modify its administration and policy that the institution will bring credit to itself and will serve the best interests of the State. In order to establish and maintain the station on an efficient basis, financial aid from the State in addition to the Federal funds is very much needed.

GUAM.

Guam Agricultural Experiment Station.

JOHN B. THOMPSON, B. S., *Special Agent in Charge.*

The improvements at the Guam station during the past year included the construction of a small but convenient residence and of a small potting house and propagating shed. The tract of land transferred to the station by the governor was surveyed and platted and devoted to work with live stock.

The experiment in the improvement of horses, cattle, pigs, chickens, and other live stock of the island was given much attention during the year. A survey was made of the stock situation to put on record the conditions at the time this work was taken up. An importation of purebred stock was made and experiments were begun in breeding these purebred animals to the native stock to determine the relative practical value of these breeds.

The experiments in introducing better and more productive varieties of corn were continued and 40 varieties from different tropical countries were on trial. Of these a hard, smooth-grained yellow corn obtained from St. Vincent and a similar variety from St. Lucia produced as good or better yields than the native type and ripened in about 30 days less time.

The orchard work was largely confined to propagating mango trees by inarching and growing and distributing better varieties of bananas and other fruits. A large number of tropical and subtropical fruits, vegetables, and forage plants were tested and the station made a feature of seed and plant distribution, sending out large amounts of seeds from 2,500 seedlings, rooted cuttings, and inarched plants.

The only publication of the station during the year was the Annual Report for 1911.

HAWAII.

Hawaii Agricultural Experiment Station, *Honolulu*.

E. V. WILCOX, Ph. D., *Special Agent in Charge*.

The work of the Hawaii station for the diversification of agriculture in the islands was continued uninterruptedly and important results in some of the investigations were secured. Studies in progress for several years have demonstrated the possibility of breeding a strain of papayas with 92 per cent of fruit-bearing plants, thus making it possible to do away with the fruitless staminate plants. It was found that papayas could be readily grafted and that the process was of considerable value in propagating desirable strains. The results of some preliminary work indicated that the shape of the pineapple fruit is subject to the laws of heredity, and experiments were taken up to develop a cylindrical fruit in order to reduce losses in canning due to the use of conical fruits.

The soil survey of Hawaii was about completed. Many soils of unusual physical and chemical properties were found and their origin from lavas was traced. Studies were continued of the latex of *Euphorbia lorifolia*, the value of which was discovered and reported a year ago. A series of experiments showed that the pineapple juice wasted in canning processes may be readily converted within 24 hours into a vinegar containing 3.5 to 4.5 per cent of acetic acid. It was shown that kukui nuts have a value of at least 1½ cents a pound for oil and fertilizer, and as a result several firms are preparing to collect the nuts and produce the oil. The development of the algaroba-bean industry proceeded rapidly during the year and the use of the meal was included in the ration for army horses in Hawaii. Dynamite was satisfactorily employed for loosening the soil and providing drainage in pineapple field and rubber plantations.

Considerable cooperative demonstration work was carried on, largely with funds provided by the Territorial legislature. Six substations have now been established on different islands.

Bulletins 27 and 28, Press Bulletins 35 to 41, and the Annual Report for 1912 were received from this station during the year.

IDAHO.

Agricultural Experiment Station of the University of Idaho, Moscow.

W. L. CARLYLE, M. S., *Director.*

The work in progress at the Idaho station during the past year included studies of factors influencing the composition and quality of wheat, more particularly the gluten content and baking properties, pathological and breeding investigations with the apple, the utilization of fruit and vegetables for preserving and canning purposes, the improvement of field corn, culture, variety, and rotation tests with field and garden crops, and feeding experiments with dairy cows, lambs, and pigs.

Under the Adams fund, the study on the keeping quality of butter showed that in general sweet-cream butter keeps and ripens well, and that rancidity may result, in part at least, from a high acid content of the cream when churned, as a purely chemical change, without the intervention of bacteria. In connection with the apple-breeding project of the station, 3,097 trees were grown in 1913 from 3,552 seeds secured in crossing several of the more important common varieties.

Under Hatch and State funds, among other data, results were secured indicating that fruits in general when grown without irrigation exhibit a well-defined tendency to elaborate greater percentages of total solids or dry matter, and consequently of sugar, acid, and crude protein, than when grown with irrigation. The station also demonstrated that tomatoes can be profitably and successfully raised in many sections of the State, and that trimming, pruning, and staking the plants are not desirable or profitable under Idaho conditions.

Work in animal feeding indicated that in Idaho alfalfa hay may be marketed through the fattening of average range lambs at a return of from \$9 to \$15 per ton. In experiments conducted in this connection on the relative value of wheat, oats, and barley as substitutes for corn fed with alfalfa, the best results were obtained with wheat, which gave especially satisfactory results when combined with about one-fifth of the grain ration of oats.

A division of soils was established and the poultry work was organized as a separate department. A farm for demonstrating the live-stock and dairy possibilities on the cut-over stump lands of

northern Idaho was established at Sandpoint, where 170 acres of land was donated. In addition, \$4,950 was received from various sources and all the lumber for buildings and fences was also contributed. For the biennium the State appropriated for the demonstration farms and substations, \$26,000; poultry work, \$3,000; live-stock work, \$4,000; orchard-irrigation studies, \$5,000; and work on the alfalfa weevil, \$4,000.

Bulletins 73 to 76 were received from this station during the year.

The progress of the Idaho station toward a more thorough and broader organization, as well as in the improvement of equipment and conditions generally, is resulting in a higher efficiency and a greater benefit to the agriculture of the State.

ILLINOIS.

Agricultural Experiment Station of the University of Illinois, *Urbana*.

EUGENE DAVENPORT, M. Agr., LL. D., *Director*.

During the year 1912-13 the Illinois station carried on soil studies, including pot and field experiments to determine the possibilities and means of making plant food available in particular through biochemical agencies, breeding work with field crops, including corn, oats, wheat, clover, alfalfa, and soy beans, variety and culture tests in agronomy, investigations in animal feeding, breeding, and inheritance, economic studies in animal husbandry, including dairying, experiments in feeding and raising dairy cattle, and experimental work in floriculture, vegetable gardening, and other lines of horticulture.

As heretofore, the investigations under the Adams fund were confined to three departments. The study of the digestion and utilization of feeds in maintenance, growth, and fattening indicated a variable maintenance requirement in pigs as determined by the plane of nutrition. Pigs kept on a low nutritive plane seemed to require for maintenance per hundred pounds live weight per day approximately 0.10 pound digestible crude protein, 0.25 to 0.40 pound digestible carbohydrates, and 0.03 pound digestible ether extract. Physiological studies in cattle-feeding experiments showed the effect of deficiency in protein in the inflammation of the kidneys and other organs and in the reduction of the skeleton, particularly in the size and structure of the bones.

The work pursued with Hatch and other funds was quite extensive. In plant-breeding work with corn the selection for high and low position of ears as a result of 10 years' work has shown a difference of about 4½ feet in the position of the ear on the stalk. The yields of the two extreme strains were about equal, but the ears pro-

duced low on the stalk were somewhat earlier and the plants manifested greater storm resistance.

A comparison of balanced with unbalanced rations for feeding dairy cows indicated that the quality of the ration affects the physical constitution and through this the consumption of feed and the production of milk. The investigation on the fate of tubercle bacilli outside of the animal body reported upon during the year showed, among other things, that these bacilli were capable of living more than a year in running water and that when exposed in the manure of a naturally infected cow were dead within two weeks after exposure.

Additions were made during the year to the farm and other station equipment, including 320 acres of land, together with glass-houses and service buildings costing about \$87,000 for the department of horticulture. The station staff numbered 94, an increase of 18 over the preceding year.

Bulletins 155 to 162, Circulars 159 to 165, Soil Reports 3 and 4, and the Annual Report for 1912 were received from this station during the year.

The Illinois station, with its large resources and equipment, is pursuing fundamental work of much importance to the various agricultural interests of the State.

INDIANA.

Agricultural Experiment Station of Indiana, *Lafayette*.

ARTHUR GOSS, M. S., A. C., *Director*.

The lines of work pursued by the Indiana station in the period covered by this report included mainly feeding experiments with beef and dairy cattle, sheep, and swine, feeding and incubation work with poultry, studies of plant diseases, particularly the rusts, weed-control work, investigations on the moisture control of butter and the pasteurization of cream for butter making, milk and cream testing experiments, life-history and control work on the codling moth and the fall army worm, orchard-management studies, soil-fertility experiments, and investigations of animal diseases, particularly hog cholera. The regulatory work conducted with State funds included fertilizer, feed, and seed inspection.

The Adams fund investigations of the year included three projects. In connection with the work on rusts, a study of *Puccinia graminis* did not reveal the native host plant for the uredo stage in North America, thus indicating that this rust may be an introduced species. A study on the effect of the duration of hog cholera on the abdominal lesions seemed to show that the duration of the disease bears a direct relation to the chronic nature of the lesions. The work of the year on the pasteurization of gathered cream in relation

to bacterial flora and keeping quality of butter showed that, in most cases, pasteurization at high temperatures gave a butter of mealy flavor and greasy body. The results of chemical analyses indicated that pasteurization of the cream decreased the moisture and curd content while it increased the fat content of the butter.

The progress of the work supported by Hatch and miscellaneous funds included among other results, the completion of studies with tomatoes and of feeding trials with lambs and steers. Average cultivation of tomatoes, consisting of about eight cultivations and one hoeing, gave better returns than either a greater number of cultivations by itself, or of cultivations and hoeings together. The result of winter steer-feeding experiments showed that the substitution of corn silage for clover hay in a ration of shelled corn, cottonseed meal, and clover hay reduced the cost of gain, and that a similar result was secured in feeding oat straw instead of clover hay in a ration of shelled corn, cottonseed meal, dry roughage, and corn silage.

Under an appropriation of \$120,000, a tract of 120 acres was acquired for the conduct of all field-crop and soil work. The enforcement of laws providing for stallion registration and the testing of all creamery and dairy glassware was placed in the hands of the station. Under a law providing \$15,000 annually for the purpose the veterinary department of the station was charged with the testing of all serums, vaccines, and similar remedies and preventives.

Bulletins 144 (revised) and 158 to 165, Circulars 23 (revised) and 38, and the Annual Report for 1912 were received from this station during the year.

The Indiana station, with its provision of funds and its extensive equipment, is progressive, and the value of its work is attested by the support given and the confidence imposed by an intelligent farming population.

IOWA.

Iowa Agricultural Experiment Station, Ames.

C. F. CURTISS, M. S. A., D. Sc., *Director*.

The more important lines of work followed by the Iowa station the past year included cultural and other experiments with field and forage crops, breeding studies with field and orchard crops, soil-fertility experiments, and chemical and bacteriological investigations of soils, dairy bacteriological studies, together with work on toxicity and the pasteurization of milk, chemical and bacteriological studies of corn silage, investigations on animal nutrition and breeding, poultry breeding and feeding, insect life-history work, studies of plant diseases, and studies in agricultural engineering pertaining mainly to silo construction and the use and standardization of farm implements and machinery.

The investigations under the Adams fund were limited to the five research projects in force. In the study of inheritance in cattle breeding, the polled character was found dominant in both sexes, and among color characters black was dominant to red, while white seemed to be a limiting character. Data obtained in the soil investigations indicated that the amino acids and acid amids examined were readily ammonified in the soil and that the transformation was greatly influenced by the chemical structure of these compounds, amino acids and acid amids of equal structure yielding about the same proportion of ammonia.

A large amount of work financed with Hatch and State funds was in progress in the different station departments. The department of chemistry found that lactic acid is normally present in silage in excess of the volatile acids. All samples of good silage examined were found to contain a considerable amount of volatile aliphatic acids and that acetic acid comprised about nine-tenths of the total volatile acid present, propionic acid being next in importance.

Feeding experiments showed that grinding materially increased the digestibility of corn when fed to old hogs, while with young animals ear corn was as efficient as ground corn. The protein in the winter rations of brood sows and ewes was found to have an important influence on the vigor of the offspring. Work on the germination of seed corn showed that ears with horny kernels out-yielded those with starchy kernels and that the most rapid early growth in the field was also in favor of the hornykerneled ears. In soil bacteriological studies the greatest number of organisms was found to occur at a depth of 4 inches and rotation of crops seemed to favor an increase in the number as compared with continuous cropping.

Under a State appropriation for the purpose a 160-acre farm was purchased for the field work of the station on crops and soils. The mailing list increased by approximately 5,000 names during the year and now includes the names of about 17,000 farmers.

Bulletins 132 to 138 and Research Bulletins 4 to 8 were received from this station during the year.

The Iowa station is in close touch with the people of the State and is accomplishing much in the way of helping the Iowa farmers to solve their various problems.

KANSAS.

Kansas Agricultural Experiment Station, Manhattan.

W. M. JARDINE, B. S. A., *Director.*

The Kansas station actively pursued many lines of work during the past year. Attention was principally given to plant breeding, especially with wheat and alfalfa and pure strains of different crops, control of insects, including the Hessian fly, chinch bug, plant lice,

and mill pests, diseases of horses and hogs, nutrition of pigs and steers, inheritance in insects and farm animals, tapeworms in animals, poultry breeding, different kinds of silage for animal feeding, soil culture and fertility, fruit-bud formation with reference to pruning, and drought resistance in crops.

The Adams fund work of the station was confined to animal husbandry, chemistry, entomology, zoology, botany, and veterinary science. The results of entomological studies, including life history and control work on insects infesting mills and grain-storage houses, were reported. It was found that many insects do not yield readily to hydrocyanic-acid gas, but that no mill insect can withstand for any length of time a temperature of 118° to 122° F. The study of inheritance in Orthoptera showed that certain distinct patterns do not behave as Mendelian unit characters, and in the parasitological investigations it was discovered that a species of barnyard earthworm is the intermediate host of a roundworm infesting the intestines of chickens.

Other lines of work were supported by Hatch and State funds. Soil-fertility experiments showed that the use of phosphorus in growing alfalfa gave a decided increase in yield, and in testing different methods of seed-bed preparation the highest yields of winter wheat were obtained from early summer plowing. Egg counts of different plantings of corn in connection with work on the corn earworm indicated that corn planted May 1 is subject to infestation with the smallest number of eggs. At the substations work in soil culture, crop rotation, cereal improvement, development of drought-resistant forage crops, dry-land farming, and irrigation was conducted in cooperation with this department.

A number of improvements in the equipment of the station, including the construction of two silos of 240 tons capacity each, were made during the year. The State appropriations, including those for the substations, amounted to \$68,000.

Bulletin 182, Feeding Stuffs Bulletin 23, and Circulars 25 to 28 were received from this station during the year.

The progressive improvement in the organization of the work of the Kansas station includes the placing of all experimental effort on the basis of definitely outlined projects. The activities of the station are increasing, the outlying experiments are assuming more importance, and much good work is accomplished.

KENTUCKY.

Kentucky Agricultural Experiment Station, Lexington.

J. H. KASTLE, Ph. D., *Director.*

The Kentucky Experiment Station during the past year pursued as its principal lines of work culture experiments with corn, wheat, oats, tobacco, alfalfa, sweet clover, soy beans, and other forage crops,



FIG. 1.—EXPERIMENTAL DAIRY BARN AND PORTION OF THE HERD, IOWA STATION.

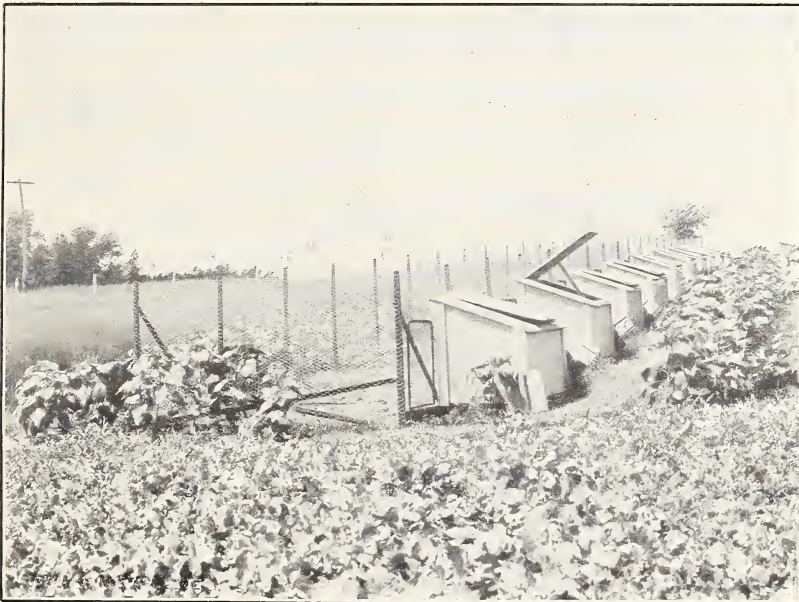


FIG. 2.—INDIVIDUAL HEN TEST PENS, FOR EXPERIMENTAL WORK IN FEEDING AND BREEDING, IOWA STATION.



FIG. 1.—KENTUCKY STATION: ADDITION TO MAIN BUILDING, MORE THAN DOUBLING ITS CAPACITY.

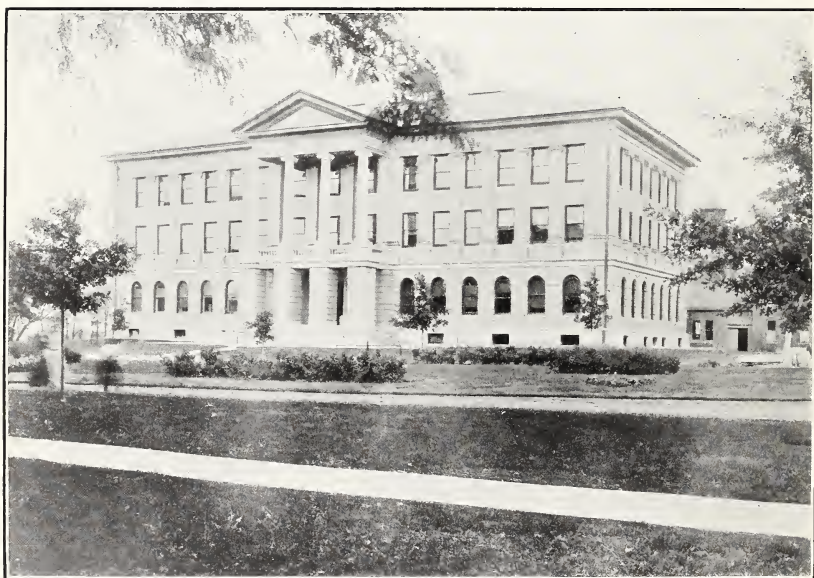


FIG. 2.—PLANT INDUSTRY HALL, NEBRASKA UNIVERSITY AND STATION, COMPLETED IN 1913.

rotation experiments in cooperation with this department with cereals, hemp, tobacco, leguminous forage crops and grasses, breeding work with tobacco for the improvement of native strains of the Burley type, improvement in methods of curing tobacco, preparation and distribution of hog-cholera serum, investigations on diseases of farm animals, studies of the nodule bacteria of leguminous plants, insect life-history work, and soil studies with reference to sulphur content. Under State provision the station carried on extension work largely as a cooperative feature, and enforced the fertilizer, food and drugs, feed and nursery, and seed-inspection laws.

The Adams fund investigations included, among other work, a study of the etiology of contagious abortion in mares, resulting in the isolation of the causal organism and the production of the disease in 11 days after experimental inoculation. The organism was found to cause abortion also in guinea pigs, sheep, and other animals and to prove fatal to rabbits. A study of clover bloat indicated that the disease is due to the evolution of carbon dioxid resulting from the fermentation of the sugar in the clover bloom by the action of the yeast present in the plant. In the study of the sulphur content of soils, samples from the better agricultural areas were found to be the higher in sulphur as well as in phosphorus content. The investigation of the action of barium in plant metabolism showed that legumes made a better growth and more nodules were produced on their roots when the soil was supplied with the element.

The work conducted with Hatch and other funds included variety tests with wheat which further confirmed the superiority of the Jersey Fultz variety for Kentucky conditions, and cooperative culture and fertilizer tests in which on one small field the use of rock phosphate at a cost of \$2 per acre apparently raised the acre yield of corn from 7 to 46 bushels, and on another field the application of acid phosphate and limestone more than doubled the yields of corn and cowpeas as compared with untreated land. Experiments conducted with fumigants indicated that the use of hydrocyanic-acid gas, carbon bisulphid, and carbon tetrachlorid had apparently not affected the viability of seeds under test. The results of work on the solution in dilute acid of limestone ground to different degrees of fineness pointed out that for agricultural purposes limestone should be ground to pass through a 10-mesh sieve. A volumetric method for the analysis of lime-sulphur solutions was devised.

The improvements during the past year included the establishment of four outlying experiment fields, the enlargement of the station building (Pl. II, fig. 1) at an outlay of \$70,000, the construction at a cost of \$12,000 of a hog-cholera serum laboratory to replace a smaller

structure, and other more general additions to office and laboratory equipment.

Bulletins 158, 162, 166, 167, 169, 170, and 171 were received from this station during the year.

The far-reaching activities of the Kentucky station are creating an ever-increasing interest in scientific agriculture on the part of the farmers of the State.

LOUISIANA.

No. 1. Sugar Experiment Station, *Audubon Park, New Orleans.*

No. 2. State Experiment Station, *Baton Rouge.*

No. 3. North Louisiana Experiment Station, *Calhoun.*

No. 4. Rice Experiment Station, *Crowley.*

W. R. DODSON, A. B., B. S., *Director, Baton Rouge.*

The work of the Louisiana stations during the year ended June 30, 1913, related mainly to testing new foreign varieties of sugar cane, fertilizer and rotation tests on cane fields, methods of clarification in the manufacture of white sugar, clarification of sirups, evaluation of sugar by-products, causes of sugar deterioration, fermentation of canned cane sirup, sugar-cane and rice insects, plant diseases, mainly bean blight, cotton-boll rots, tomato wilts, and diseases of sugar cane and alfalfa, toxicity of cottonseed meal, animal diseases, especially anthrax and cerebrospinal meningitis, heat transmission in sugar-house heating apparatus, and culture of various field and garden crops. Under State funds the station conducted the fertilizer and feeding stuffs control work.

Progress in the Adams fund work was reported. In connection with the study of nonsugars in sugar cane a method for the extraction of sugar by means of saccharates was developed and a direct method for the determination of sucrose by destroying glucose with alkali was perfected. Work was also done on the determination of levan in sugars and a bulletin was published on the subject. The bacterial study of raw sugars and sugarhouse products indicated that sugar organisms are generally resistant to high temperatures. Certain yeasts, apparently growing in stronger concentrations than bacteria, were discovered in sugar and one of the types isolated caused the most rapid deterioration of any of the organisms studied. In the investigation of anthrax, inoculation with dead cultures was reported as quite successful.

Work under Hatch and other funds was in progress at the station and the substations. By feeding hogs sweet potatoes, cottonseed meal, and rice polish 1,825 pounds of pork were produced per acre. The profitable production of cauliflower for northern markets was demonstrated during the year, and saving bean seed from the spring crop was found possible by thoroughly drying in the sun, killing the

weevils by fumigation, and preserving the seed in air-tight containers. The results of alfalfa experiments indicated the necessity of inoculation for the hill soils in the northern part of the State.

The State appropriated \$17,000 for the station work in the State, to which about \$14,000 was added from the fertilizer fund.

Bulletins 135 to 140, the Fertilizer Report for 1911-12, the Feed Stuffs Report for 1911-12, and the Annual Report for 1911 were received from this station during the year.

The Louisiana stations cover a wide field of work representative of the different agricultural pursuits of the State and give much assistance to a loyal following.

MAINE

Maine Agricultural Experiment Station, Orono.

C. D. WOODS, Sc. D., *Director*.

The subjects of investigation and study at the Maine station during the past year included the physiology of reproduction and the mode of inheritance of fecundity in poultry, the histology of the oviduct of the domestic hen, the improvement of sweet and field corn, isolation and propagation of pedigreed strains of oats, the pollination of beans, the inheritance of milk production in cattle, apple breeding, insect life history, diseases of the apple and the potato, and the genus *Fusarium* as a cause of plant disease. Experiments were also conducted in poultry management, orchard spraying, growing crops by different methods and in different rotations, fertilizer treatment of crops and soils, land preparation, including the use of dynamite, and in testing varieties. The control work of the station under State provision included the inspection of fertilizers, feeding stuffs, foods and drugs, insecticides and fungicides, and creamery glassware.

Investigations under the Adams fund constituted a large part of the station's work. Studies in poultry breeding indicated that high fecundity is not inherited by daughters from their dams, but may be inherited from their sire independent of the dam, while a low degree of fecundity may be inherited by the daughters from either the sire or the dam or both. In the study of potato scab it was shown that the spores are not all killed by passing through the digestive tract of the horse or the cow. The investigation of leaf spot and apple canker indicated that the organism causing leaf spot in Maine also causes the most common canker of the limbs.

A number of lines of work, often allied with the Adams fund investigations, were conducted with Hatch and other funds. The results in experiments with hybrid corn continued promising, and several pedigreed strains of oats yielded at the rate of over 100 bushels per acre. In breeding work with beans it was observed that

these plants are not always entirely self-fertilized, as by means of insects cross-fertilization is sometimes brought about. The results of life-history and control work on the aphid pests, spruce leaf-miners, and potato flea-beetle were published during the year. Orchard spraying experiments indicated that dry arsenate of lead and arsenate of zinc are fully as effective and safe as arsenate of lead paste.

Bulletins 197 to 212, Official Inspections 37 to 47, and Documents 435 and 467 were received from this station during the year.

The Maine station during the year continued to make good progress in its lines of work, as well as in the improvement of its equipment which the funds at its disposal allow.

MARYLAND.

Maryland Agricultural Experiment Station, College Park.

H. J. PATTERSON, B. S., *Director.*

The year's work of the Maryland station included studies of the character of milk proteids, an investigation of the effects of fertilizers on cell structure and mutations, experiments bearing on the resistance of tomatoes to leaf spot and leaf molds, studies of the chemical and physical effects of lime on soils, an investigation of metabolism in potatoes, breeding corn, wheat, and oats, variety and culture tests with cereal and forage crops, the use of green manures, experiments in horticulture carried on in the greenhouse, orchard, and garden, spraying tests for the control of plant diseases and insects, experiments with poultry in feeding, crossbreeding, and incubation, and studies on the control of hog cholera. Work on classification and life history of Ophiinae of North America and of special parasites of Aphidiinae was brought to a close during the year.

The results secured in the Adams fund investigations included very noticeable effects in size and color of plants, but without any striking effect of microscopic structure, resulting from the use of varying amounts of different fertilizer mixtures and solutions. With the maximum strength of potash solutions the cell walls appeared to be thicker and the foliage more brittle than with the weaker solutions. In the study of metabolism in potatoes, marked metabolic changes were observed during the earlier stages of sprouting in storage, the changes in many cases being most pronounced in the stem-end of the tuber. The presence of active diastase and some carbohydrate transformation but no proteolysis or other changes in nitrogen compounds were observed during after-ripening. The rest period was found entirely eliminable by proper adjustment between the bud tissue and external agents.

A number of lines of work supported by the Hatch fund were reported upon during the year. A comparison of open and closed



FIG. 1.—BUILDING FOR WORK WITH SMALL EXPERIMENTAL ANIMALS, AT THE KENTUCKY STATION.



FIG. 2.—NEW POULTRY BUILDING AT THE MARYLAND STATION.



FIG. 1.—NEW BUILDING FOR AGRICULTURAL CHEMISTRY, INCLUDING ANIMAL NUTRITION, MISSOURI UNIVERSITY AND STATION.



FIG. 2.—SCIENCE HALL, SOUTH DAKOTA AGRICULTURAL COLLEGE, OCCUPIED FOR STATION HEADQUARTERS AND LABORATORIES.

stables for dairy cows indicated an advantage in favor of the open stable in the production of milk with a low germ content. Of different methods for preventing injury by the peach-tree borer none proved as effective as "worming" the trees. Experiments with potatoes, begun in 1909, were brought to a close and the results were published in bulletin form. This work demonstrated that desirable seed tubers can be grown in the mountain districts of the State. Seed tubers kept in cold storage were found to give better results in these tests than cellar-stored tubers.

The office and laboratory building of the poultry plant was burned April 13, 1913, the estimated loss being \$4,000, covered by insurance. The construction of a new and better laboratory building (Pl. III, fig. 2) was begun toward the close of the year.

Bulletins 163 to 175 were received from this station during the year.

The Maryland station pursues lines of work of great interest to the agricultural population of the State and gives faithful attention to those problems which intimately affect the prosperity of the farmer.

MASSACHUSETTS.

Massachusetts Agricultural Experiment Station, Amherst.

W. P. BROOKS, Ph. D., *Director.*

The Massachusetts station reported as its chief lines of work for the past year a series of experiments with fertilizers and manures, variety tests of potatoes and alfalfa, studies of the composition of milk and butter fat, the secretion of milk and the cost of milk production, digestion experiments with sheep, and feeding tests with dairy animals, immunization of hogs against cholera infection, studies of heredity in poultry and of diagnosis of bacillary white diarrhea in adult fowls, spraying tests and observations on spray injury, investigation of the plant-food requirements of asparagus and cranberries, studies of plant diseases and of character transmission in plant breeding, germination and purity tests of seeds, top-working experiments with apple trees, a study of wasps as parasites, and of color vision in bees, and the collection of meteorological data. The station was also in charge of control police work conducted under State provision.

General progress in the Adams fund investigations was reported. In connection with work on asparagus it was found that the spring crop does not make a heavy drain on the store of nitrogen and nitrogen-free extract of the roots, and that this is more than made up by the material translocated from the tops as they ripen. The study of the chemical action of ammonium sulphate on soil seemed to indicate that this substance reduces the lime content of the soil through its rapid solution. A study of the relation of light to greenhouse culture,

a phase of the project on meteorological factors in relation to plant growth and diseases, was prepared for publication. The results have a bearing on the physiology and pathology of crops, as well as on greenhouse construction and management.

With Hatch and other funds the station covered a wide field of effort. Among the results secured data derived from fertilizer experiments favored the use of nitrate of soda as a source of nitrogen for onions and showed the profitableness of top-dressing pastures with a combination of basic-slag meal and potash. In an orchard experiment, low-grade sulphate of potash, applied with bone meal, gave much better returns than muriate of potash in the same combination. Sulphate of potash as a fertilizer for alfalfa also gave better results than were secured from the muriate, and Grimm alfalfa in these experiments outyielded the common variety.

The station has an annual State appropriation of \$15,000, but for the five years beginning December 1, 1913, the State provided for an annual increase of \$5,000 over the amount received the preceding year.

Bulletins 141 to 143, Meteorological Bulletins 282 to 293, Circulars 33 and 34, and the Annual Report for 1911, parts 1 and 2, were received from this station during the year.

The Massachusetts station is pursuing many different lines of important work, and the agricultural interests of the State are turning more and more to the station for advice and guidance.

MICHIGAN.

Experiment Station of Michigan State Agricultural College, East Lansing.

R. S. SHAW, B. S. A., *Director*.

The work conducted at the Michigan station during the past year related principally to better preservation, soil microbiology, animal diseases, particularly hog cholera and infectious abortion, and tuberculosis in cattle, the bacteriology of cream ripening and churning, nodule-forming bacteria on leguminous plants, vinegar organisms, organic nitrogenous compounds in peat soils, the solubility of soil phosphates, osmosis as related to the movement of soluble salts in the soil, plant nutrition and pathology, factors influencing soil temperature, insect life history and control, breeding cereals and other field crops, the use of fertilizers and the arrangement of crop rotations, the culture of orchard and small fruits, and the feeding of poultry, horses, sheep, and cattle. In addition to this work, the station was in charge of fertilizer and seed inspection under State provision.

Some of the results secured in work under the Adams fund were reported during the year. The study of the bacteriological factors influencing the keeping quality of butter showed, among other facts,

that certain acid-reducing yeasts have the property of retaining the vitality and activity of lactic bacteria over a period of a year or more when grown with them in mixed culture, in milk, or in whey. In connection with soil studies, a method for the extraction of soil solutions was perfected, and preliminary results indicated that the nutrients in the soil solution are present in a colloidal state. Work on hog cholera included a study of antigens and antibodies, and indicated that mixing the serum and virus in vitro has no advantage over the serum-simultaneous method. In the investigation of apple-tree canker the life history of the causative fungus was particularly worked out.

A large amount of work was in progress under Hatch and other funds. Plant breeding and other studies with wheat pointed out that the ordinary red wheats usually produced better bread than the pearl wheats, and that the best milling wheats and usually the best bread producers are found in the hard red wheats. Observations on alfalfa culture showed that the principal causes of failure throughout the State have been poor preparation of the seed bed and lack of inoculation. In studying a Rhizoctonia as transmitted by seed it was found that formaldehyde treatment was of little value as a control measure.

The State appropriated about \$5,000 for publications, \$2,000 for the South Haven substation, and \$12,000 for the Upper Peninsula substation.

Bulletins 268 to 271, Special Bulletins 57 to 61, Technical Bulletins 12 to 16, Circulars 14, 15, and 17 to 20, and the Annual Report for 1912 were received from this station during the year.

The Michigan station, with its present standing and equipment as a basis to build upon, will be much benefited by the promised State aid in the development of its work, and the spread of its good influence throughout the State.

MINNESOTA.

Agricultural Experiment Station of the University of Minnesota, *University Farm, St. Paul.*

A. F. Woods, M. A., *Director.*

The work of the Minnesota station the past year was mainly along the lines of improvement and culture of field, orchard, and garden crops, cost of crop production, crop rotation, farm management, weed eradication, baking quality of flour, plant diseases and disease resistance, soil moisture and fertility, sorghum-sirup production, the value of wild rice for food, meat production and feeding standards, rations for dairy cows, swine, and poultry, crop pests, preservation of fence posts, and diseases of live stock, particularly hog cholera and swamp fever.

The investigations carried on with the Adams fund included work on two new projects. Studies, dealing mainly with the properties of the blood of animals kept in badly ventilated stalls, revealed no constant or striking abnormalities. A study of the surface tension of water and of organic liquids of varying density, in connection with the soil-absorption investigations, resulted in the establishment of a definite constant for the relation of this surface tension to the absolute surface tension as given by authorities on the subject. Investigations on the effect of different systems of cropping upon the humus content of the soil and the associated plant were completed, the result showing a marked loss of organic matter in the cultivated soils as compared with virgin soils.

A large amount of work was carried on in addition to the Adams fund projects. The field work in plant breeding has given rise to a number of varieties and strains of practical value, including especially varieties of corn and alfalfa. The results of 10 years' study of cost accounting on the farm were prepared for publication, and a simple system of farm records based on this work was outlined. A study of sterility in grapes was completed, and the improvement of types of plums, raspberries, strawberries, and grapes was continued. The chemical work completed during the year included experiments in the manufacture of alcohol from corn in a plant of small capacity, which indicated the undertaking to be unprofitable.

The State appropriations for the biennium beginning August 1, 1913, included an increase of approximately \$40,000 for the station and of \$20,000 for extension work, together with allowances of \$18,250, available in 1914, for additions and alterations in the veterinary-pathology building, \$15,000 for grading and fencing, about \$20,000 for minor buildings and alterations, and \$25,000 for county agents. The State also appropriated \$267,000 for substations and provided \$5,000 per year for seed inspection.

Bulletins 127 to 131 were received from this station during the year.

Changes in organization, additions to the staff, construction of new buildings, and improvements generally have enabled the Minnesota station to concentrate its efforts on the lines of research and experimentation best adapted to the solution of the important agricultural problems of the State.

MISSISSIPPI.

Mississippi Agricultural Experiment Station, *Agricultural College*.¹

E. R. LLOYD, M. S., *Director*.

The work of the Mississippi station the past year progressed in a satisfactory manner and related mainly to the breeding of mules and

¹ Telegraph address, *Starkville*; express and post-office address, *Agricultural College*; freight address, *A. and M. College Station*.

cattle, plant breeding, particularly cotton, the life history and control of scale insects, bean leaf-beetle, and peach-tree borer, biology and control of species of crawfish injurious to agriculture, transmission of hog cholera, green manures as affecting soil bacteria, forage crops, including alfalfa, clovers, cowpeas, soy beans, and Sudan grass, harvesting and storing sweet potatoes, cost of winter feeding mares and mules, cattle feeding, the effect of rations on egg production, and the cost of poultry keeping for egg and meat production.

The lines of work under the Adams fund were the same as in the preceding year. A study of sterility in mules was pursued as a phase of the investigations on mule breeding. Mule colts from mares of the larger breeds did not seem to withstand the hot summers quite as well as those from mares of the smaller breeds. Results in cotton breeding seem to show that long staple and earliness are negatively correlated characters. A number of species of insects not hitherto reported as affecting the pecan were found, and in the control of crawfish carbon bisulphid and miscible oils gave good results.

Work under Hatch and other funds included experiments on the maintenance of mules, the results showing that at the station \$76 was required for feed to rear a 3-year-old mule colt. When fed a maintenance ration, 2 and 3 year-old mules were wintered for 150 days for a feed outlay of \$11.63, and colts were fed from weaning time through the winter at a cost of \$16.18. In experiments with cotton, the best results were obtained by planting the rows $3\frac{1}{2}$ feet apart and placing the plants 1 foot apart in the row, and the yield of seed cotton was apparently increased by more than 300 pounds per acre as due to an application of 10 tons of manure. The use of both nitrogen and phosphorus, alone or in combination, gave satisfactory returns and the phosphorus appeared to hasten maturity. A comparison of the form and structure of hybrids between species of tobacco and between radish and kohlrabi, with the form and structure of the parents, indicated a close relation between external and histological characters. The work carried on at the various substations included numerous experiments with fertilizers and dairying, the production of cotton, corn, and pork, and the growing of fruit and vegetables.

Some additions to the station buildings were made, including a bacteriological laboratory and greenhouse costing \$3,500.

Bulletins 158 to 161, Technical Bulletins 2 to 4, Circular for August, 1912, and the Annual Reports for 1909 and 1910, were received from this station during the year.

The Mississippi station actively pursued its different lines of work during the past year and brought its influence to bear on the agricultural practices of the State. Through its work on animal feed-

ing and the demonstration of the value of silage many farmers throughout the State were induced to build silos.

MISSOURI.

Missouri Agricultural College Experiment Station, *Columbia.*

F. B. MUMFORD, M. S., *Director.*

The lines of work receiving principal attention at the Missouri station during the past year included experiments in the feeding, breeding, and management of sheep; the use of different forage crops for hogs and the methods of feed preparation for steers and other stock; studies of the nutrient requirements for milk production and fetus development in cows; life history and other studies of important insect pests; experiments in crop rotation and in the culture and improvement of different field and horticultural crops; forest and farm management; and investigations in plant pathology and cytology, more particularly diseases of the tomato, smuts and rusts of cereals, and microorganisms in silage.

General progress in the Adams fund work of the station was reported. A study of the effect of feed on the composition of milk and milk fat, carried on principally with cottonseed meal, showed that the character of the other feeding stuffs in the ration exerted a marked influence. The rest period of seeds of various species was successfully broken by artificial freezing, mechanical opening of the shell, the use of ether, and other similar processes. Investigations on the nutrition of the peach are reported in which the use of one-half pound of nitrate of soda per tree advanced the time of bearing and caused the trees to hold their leaves later in the fall and to start bud growth later in the spring. The results of three years' work indicated that a large yield of ear corn is associated with a dense rather than a starchy kernel and with a large germ rather than with a small one. Work on mildews pointed out the susceptibility of varieties of wheat from Egypt and Palestine, the general resistance of varieties, except the winter varieties, and the limitation of oat mildew to that particular plant.

Under Hatch and other funds attention was given to studies along a number of different lines. Observations on the effects of parental age on individual offspring and on the race in hogs indicated that pigs from mature parents grow faster and that lactation stops the growth of the mother. In an experiment on the value of breeding in rams, lambs from a purebred ram sold for \$1.25 more per 100 pounds than lambs from a scrub ram. The results of cattle-feeding experiments showed that, as compared with other lots, the one receiving a ration of shelled corn, linseed-oil meal, corn silage, and clover hay made maximum gains in live weight, produced the most

economical gains, was the best finished, and yielded the greatest profit per head. Blue grass, with an average return of \$22.53 per acre for four years, proved to be better forage for shoats than any one of a number of combinations of crops grown in rotation for this purpose. The veterinary department gave much attention to work with hog cholera. For the biennium beginning January 1, 1913, the station received a State appropriation of \$30,000.

Bulletins 105 to 109, Research Bulletin 6, Circulars 56 to 58 and 60, and Index to Bulletins 97 to 104, were received from this station during the year.

The Missouri station shows favorable development in the amount of definite experimental work in progress and in the growth of work of a strictly research character. The continued liberal policy of the State toward the station can not fail to bear satisfactory results.

MONTANA.

Montana Agricultural Experiment Station, Bozeman.

F. B. LINFIELD, B. S. A., *Director.*

The Montana station gave attention during the past year largely to variety, culture, irrigation, and fertilizer tests with field crops, wool testing, feeding experiments with hogs, life-history and control studies of the spotted-fever tick and the sugar-beet root-louse, combating insects and plant diseases, culture and variety tests of fruits and vegetables, observations on the adaptability and profitableness of poultry breeds, artificial incubation, investigations of the development and control of nitrates in the soil, determination of the chemical changes in clover silage and of its nutritive value compared with that of clover hay, and studies of contagious abortion, swamp fever, and hog cholera.

Progress was reported in most of the Adams fund projects, and among other things it was found that the amount and distribution of nitrates in soils bore a distinct relation to the moisture and the cropping systems. On fallow, the soil nitrate content was higher than on cropped land, and on summer fallow the nitrate content was highest in the fall, while on land producing crops it was highest in the spring. All plants showed an accumulation of nitrates, except those in alfalfa and brome grass, on which the nitrate content was low at all seasons.

A complete life history of the sugar-beet root-louse (*Pemphigus betæ*) was worked out, and an effective means of control by methods of applying irrigation water was established. The effects of different arsenical compounds on the physiology and growth of fruit trees and other plants were determined, with the result that applications of amounts equivalent to 20 years' average spraying showed

distinct poisoning in most cases. It was further shown that these compounds retarded transpiration and interfered with photosynthesis.

Among the different lines of work under Hatch and other funds, experiments in thinning fruit indicated a relationship between the amount of foliage on a fruit spur and the size and date of ripening of the fruit growing on it. In feeding trials with pigs shorts fed with sugar beets produced more economical gains than when barley or frosted wheat were substituted. Results secured in studies on contagious abortion showed that carbolic acid either fed in solution or injected hypodermically acted as a specific against the disease.

The available State funds for the year amounted to \$43,500 for the station and \$20,000 for substations and demonstration farms. A department of farm management was established and the station farm was increased to 300 acres by the addition of 160 acres.

Bulletins 87 to 91, Circulars 7 to 19, and the Annual Report for 1911 were received from the station during the year.

The Montana station during the past year expanded its organization in various directions, increased its acreage for experimental field work, and strengthened its position generally for meeting the demands of agriculture within the State.

NEBRASKA.

Agricultural Experiment Station of Nebraska, *Lincoln*.

E. A. BURNETT, B. S., *Director*.

The Nebraska station during the past year had in hand a number of lines of important work. Investigation was made of heredity in plants, particularly beans and corn, the water requirements of crops, including corn, sorghums, and durum wheat, the effects of close-breeding in maize and of soil moisture in relation to winter injury of fruit trees. Studies were conducted on the chemical and physical properties of soils, plant diseases, especially apple blister canker and potato leaf-curl and blight, insects in their relation to alfalfa-seed production, the improvement of winter wheat and oats, crop rotation and fertilization, silage for beef production, and rations for dairy cattle. At the substations work was confined largely to feeding experiments and crop-culture tests. Under State provision, insect inspection and hog-cholera-serum production were carried on.

The Adams fund work of the station was generally progressive. Dry rot of potatoes was studied and the disease found due to a new species of *Fusarium* which was described as *F. tuberivorum*. It was determined that the injury caused by the organism may be reduced by fungicidal treatment before tubers go into storage. Results with

reference to the inheritance of quantitative characters in maize were published during the year. Close breeding of corn studied in 10 different strains appeared to cause rapid deterioration. Studies of competition in cereal culture showed that seed from corn grown under severe competition was more responsive when planted under normal conditions than seed grown under exceptionally favorable circumstances.

The work supported by Hatch and State funds included the distribution of four strains of Turkey Red wheat which, in comparison, had given on an average 4 bushels more per acre than the standard varieties. Kherson proved superior to the other varieties of oats tested at the station. Inoculation experiments with alfalfa gave the best results where the land was treated with barnyard manure and inoculation was effected with soil from a well-established alfalfa field. Among other data obtained in feeding silage for beef production it was shown that feeding corn silage as compared with pasturing produced a much higher quality of beef.

The station received about \$20,000 from the State for investigation. A plant-industry building was completed at a cost of \$85,000, and for its equipment an additional sum of \$12,500 was expended. A serum-production plant was established under a State appropriation of \$30,000. For the biennium beginning April 13, \$74,000 was appropriated for the four substations.

Bulletins 124 and 130 to 137 and the popular edition of Bulletin 138, Research Bulletins 1 and 2, and the Annual Report for 1911 were received from this station during the year.

The Nebraska station continues to broaden its work, to improve and extend its equipment, and to grow in the appreciation of the farmers of the State.

NEVADA.

Nevada Agricultural Experiment Station, Reno.

S. B. DOTEN, M. A., *Director*.

The subjects given principal consideration by the Nevada station during the past year were insect parasitism, life history and control of the potato eelworm, control of the European elm scale, meteorology and climatology with special reference to frost and its prediction, the classification and economic value of indigenous species of *Trifolium*, nitrogen in its relation to the organic constituents of alfalfa, isolation of active principle in poisonous plants, fixation of nitrogen, the determination of essential oils in several species of pines and their analysis, feeding hogs and dairy cows, irrigation in field and orchard, frost prevention, grasses and other forage plants of value on the ranges and native meadows, and the study of equine anemia and other animal

diseases. In addition to these activities the station conducted the inspection of seeds and of weights and measures and the food and drug control.

Results secured under the Adams fund included the completion of one group in the study of native clovers. These were all found to be self-fertilized, and the seeds of some of the species were observed not to germinate readily. In the work on the organic constituents of the alfalfa plant two ketons, meristone, and alfalfone were isolated from the stems and leaves. Meristone has been produced synthetically, but has never before been obtained from the natural product, while alfalfone is a newly discovered compound. In connection with the study of soil bacteria as affected by irrigation it was found that in the particular soil under investigation ammonification proceeded most rapidly with 25 per cent of moisture in the soil and nitrification with 19 per cent.

Under the Hatch fund irrigation experiments were carried on with wheat and oats receiving different depths of water, and the yields were in favor of 0.92 acre-foot for wheat and 1.08 acre-feet for oats. The results of feeding soiling crops to cattle showed that rye and vetch were used profitably in milk as well as in flesh production. Feeding alfalfa silage gave no advantage over the use of alfalfa hay. Orchard experiments indicated that on deep soils without hardpan apple trees after the first few years will grow successfully without irrigation.

The State appropriated \$5,000 for the support of the station during the year.

The Annual Reports for 1911 and 1912, the Report of the Department of Food and Drugs Control for 1912, and the Annual Report of the Department of Weights and Measures for 1912 were received from this station during the year.

The Nevada station has passed through a year of considerable unrest and lack of close cooperation. With a clear purpose, more united effort, and a closer administration it should become a much stronger and more effective institution.

NEW HAMPSHIRE.

New Hampshire College Agricultural Experiment Station, *Durham*.

J. C. KENDALL, B. S., *Director*.

The principal lines of study conducted by the New Hampshire station during the past year included work on control of root and apple maggots and black flies, fruit-bud formation of the apple, availability of potash in soils, sheep breeding and feeding, the use of fungicides and insecticides and their effects on plants, the application of fertilizers on grasses and potatoes, the breeding of carnations,

alfalfa, and timothy, together with the study of heredity in vegetables, plant diseases, especially pine blight, point rot of apple and apple scab, soil moisture as a limiting factor in crop production, raising forest-tree seedlings, and forest planting. Under State provision the station was in charge of the fertilizer, seed, and feeding-stuffs inspection.

Among the Adams fund investigations the study of the apple maggot was practically completed and the data prepared for publication. It was discovered that a considerable percentage of the adult flies of the species are apparently retarded in development; thus supplying conditions for reinfestation and having an important bearing on control measures. Incidental to work on fruit-bud formation, it was observed that the number of fruit buds appeared to be largest where the supply of the material in the branches was most abundant, as shown by the growth of the twigs. A dry season seemed to favor production of fruit buds rather than making growth. The data secured in the investigation of the availability of potash in clay soils showed that the use of certain fertilizers as the result of a chemical reaction increased the solubility and availability of soil potash.

Data obtained in connection with Hatch fund work demonstrated that the temperature of the solutions in the preparation of Bordeaux mixture as well as the method of combining the solutions influences the rate of settling. The results of crossing varieties of muskmelons showed that the Mendelian characters are generally in the inheritance of shape, color, ribbing, netting, and type of flesh. The strains now breed true and the characteristics are marked.

In addition to giving financial aid in the maintenance of the station, the State has appropriated \$8,000 for establishing a poultry department.

Bulletins 157 to 162, 164, and 165 were received from this station during the year.

The New Hampshire station is doing good work and is well organized. Its business has been systematized and its work is favorably received by the farmers throughout the State.

NEW JERSEY.

New Jersey State Agricultural Experiment Station, *New Brunswick.*

New Jersey Agricultural College Experiment Station, *New Brunswick.*

J. G. LIPMAN, Ph. D., *Director.*

The principal investigations and experiments conducted by the New Jersey stations during the past year dealt largely with inheritance in correlation and plant breeding, the development and structure of plants as affected by certain quantities of various salts, the

influence of varying physiological conditions and environment on plant growth, the availability of nitrogenous fertilizer materials, the accumulation and utilization of atmospheric nitrogen, problems relating to oyster culture, plant diseases, especially apple and sweet-potato rots, peach yellows, potato diseases, and storage rot of the dahlia root, the use of greenhouse insecticides and the control of mosquitoes, root maggots, peach-tree borer, and plum curculio, the culture of orchard and garden crops and ornamental plants, poultry feeding, breeding, and incubation, dairy management, and weed seed and weed eradication. The State station devoted a large portion of its resources to the control work provided for in the fertilizer, feeding-stuffs, and insecticide laws.

The Adams fund work of the station consisted of studies in soil chemistry and bacteriology and plant physiology and breeding. Studies in plant breeding with the tomato indicated that inheritance follows the geometrical instead of the arithmetical mean. Work on the availability of nitrogenous fertilizer materials indicated that nitrogen in the form of calcium and sodium nitrate, ammonium sulphate, and calcium cyanamid had a higher availability and percentage of recovery than when applied in the form of dried blood, fish, and concentrated tankage. It was also found that mixing sand with heavy shale soil improved aeration and drainage and resulted in a more complete utilization of soil nitrogen. The beneficial effects of manure appeared to be physical and biological rather than chemical.

Work carried on with Hatch and State funds showed, among other results, that under favorable conditions nonleguminous plants associated with leguminous crops may secure large amounts of nitrogen from the latter. It was observed that leguminous plants seemed to differ in their capacity to supply nitrogen compounds to nonlegumes in mixed growths. Under a special State appropriation of \$30,000 the mosquito-control work was successfully continued, and practically all large areas have now been cleaned up, resulting in a large increase in the value of the land deriving the benefits of the treatment.

Among the State appropriations more directly benefiting the station may be mentioned \$12,000 for a dairy barn, \$8,000 for completing the greenhouses, \$3,000 for maintenance of the poultry department, \$3,000 for floricultural work, \$25,000 for station maintenance, and \$5,000 for printing and seed control.

Bulletins 243 to 255, Circulars 8 to 22 and 25, and the Annual Reports for 1910 and 1911 were received from this station during the year.

The New Jersey stations are in close contact with the farmers and are doing a large amount of work of practical interest. A large and growing proportion of the farmers of the State are looking to the station for guidance in the solution of numerous agricultural problems.

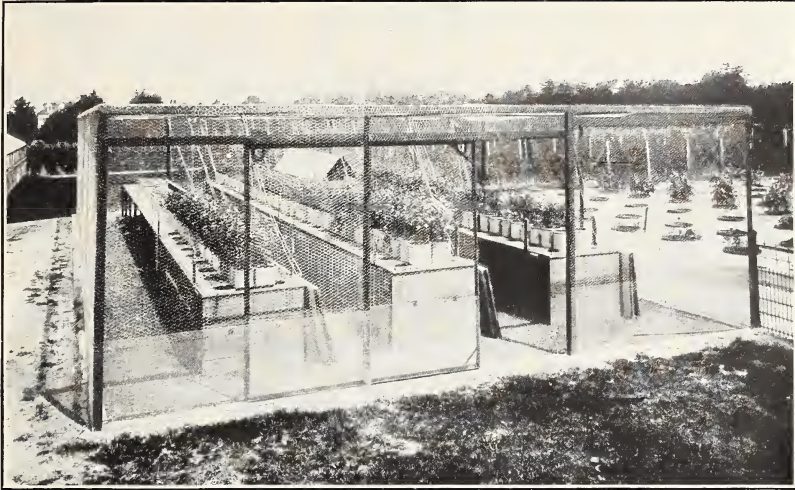


FIG. 1.—METAL CAGE FOR THE PROTECTION OF OUTDOOR POT EXPERIMENTS AT THE NEW JERSEY STATION.

[Concrete base supporting heavy angle-iron uprights, about which the remaining framework is constructed. The whole is covered with woven wire. An extra heavy wire with fine mesh extends into the concrete base.]



FIG. 2.—CYLINDER EXPERIMENTS, NEW JERSEY STATION.

[Rotation of corn, potatoes, oats, and rye repeated on different types of soil. Ripening rye protected from birds.]

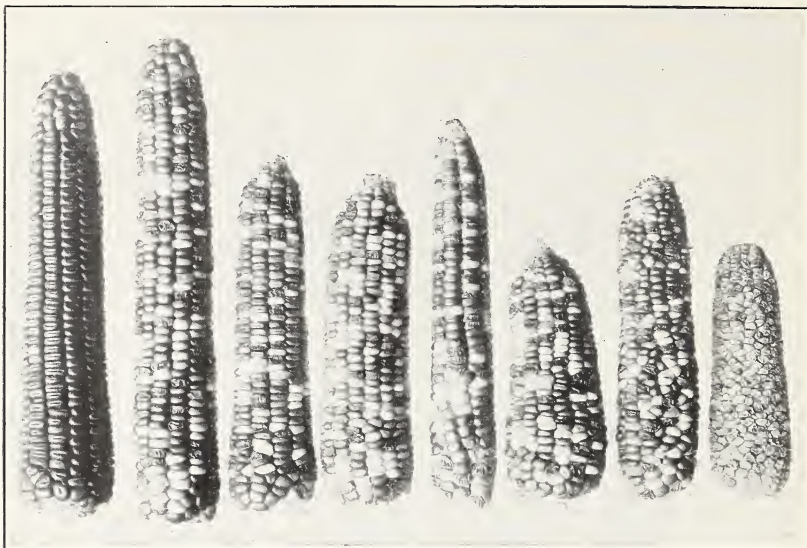


FIG. 1.—CORN BREEDING, NEW JERSEY STATION; SQUAW \times COUNTRY GENTLEMAN, F_2 .
[The contrasting parents are shown at the ends of the row and six samples of the cross between.]

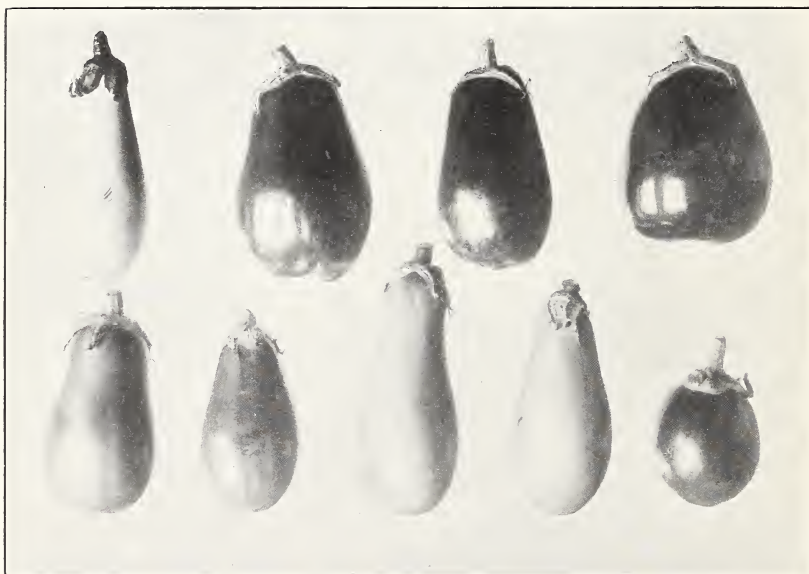


FIG. 2.—EGGPLANT BREEDING, NEW JERSEY STATION.
[Sample fruits from cross of Ivory and Round Purple.]

NEW MEXICO.

Agricultural Experiment Station of New Mexico, *State College*.

FABIAN GARCIA, M. S. A., *Director*.

The principal lines of work in progress at the New Mexico station the past year included studies of water and water sources, irrigation devices, movement of certain salts in different types of soil, hardness of fruits, and effects of pruning, observations on frost prevention in orchards, the use of pure stocks for the apple and the influence of cover crops in fruit culture, experiments in orchard irrigation, the application of sprays for the prevention of fungus diseases and insect attacks, and the culture of Denia onions, tests of varieties of field, orchard, and garden crops, and of methods of weed eradication, feeding experiments with dairy cows, pigs, and steers, a digestion experiment with steers, and studies in plant breeding, particularly with field crops.

Among the Adams fund projects pursued the work on grape crown gall was completed. The Vinifera grape, although quite susceptible to the disease, was found to vary widely in susceptibility among the different varieties as well as within the variety. In the study of the codling moth the method and time of spraying were determined by the life history of the insect under New Mexico conditions and the different broods produced. Work on the flow of water through submerged orifices resulted in the construction of a water-measuring device which also serves as a regulator of the flow of water from the source of supply. In connection with studies of soil-moisture movements as related to irrigation and crop production, the data obtained showed a loss through evaporation and transpiration of 1,262 pounds of water in the production of 1 pound of dry matter in wheat culture.

A variety of work was in progress under the Hatch fund and some of the results were published during the year. In the study of the composition of some New Mexico waters, black alkali was not found in any of the streams and in very few of the underground waters in the part of the State east of and including the Rio Grande. Gypsum was found in nearly all and white alkali in all the waters of this section. Results from experiments in wheat growing indicated a higher cost of production under irrigation than under humid conditions.

Recent changes on the staff of the New Mexico station included the appointment of F. Garcia as director, vice L. Foster, who entered upon the professorship of agriculture in the college.

Bulletins 83 to 85 and the Annual Report for 1912 were received from this station during the year.

The New Mexico station is in position to be of great usefulness to the agricultural development of the State, which presents many problems. The pursuit of a more stable policy, a close organization, and less interference with the station administration, together with financial aid in addition to the Federal funds, would greatly strengthen the station in its work.

NEW YORK.

Cornell University Agricultural Experiment Station, Ithaca.

L. H. BAILEY, M. S., LL. D., *Director.*

This station the past year devoted its energies largely to studies in butter and cheese making, cream testing, the composition of milk and some of its products, the efficiency of the milking machine, the cost of producing various crops, different kinds of farm practice regarding grasses and clovers, and the use of nurse crops, forest nursery practice, breeding field crops, the diseases of horticultural crops, the root-nodule organisms of leguminous plants, operations in pomology, feeding and breeding poultry, and soil technology.

The Adams fund investigations were partly reported upon during the year. A phase of the soil project, the relation of higher plants to the formation of nitrates in the soil, was completed and published as Memoir No. 1, marking the beginning of a new series of research publications. It was found that the nitrate content of soil under timothy, corn, potatoes, oats, millet, and soy beans was different for each crop when grown on the same soil, and that a characteristic relationship existed between the crop and the nitrate content of the soil at different stages of growth.

As heretofore, many lines of work were conducted with Hatch and other funds. The distribution of seed and improved strains of timothy was continued to the extent of the quantity of seed available.

Among other results in plant breeding, different strains of dent corn responded markedly to selection for earliness. In one experiment selected seed gave 72 per cent of ripe corn as compared with 13 per cent for the original unselected seed. Pure tuber lines of potatoes were found quite uniform in habit of growth, vigor, yielding capacity, shape and color of tuber, and in other characters. Within these pure tuber lines, however, variations occurred that made it possible to isolate a good-yielding, a medium-yielding, and a poor-yielding strain from the same pure line. As shown in a test of 22 varieties for two years, planting the seed end of the tuber gave an average yield about 20 per cent greater than the use of the stem end. Data were secured indicating that the ripe-rot disease of the grape is caused by the same organism that produces dead arm. The organism causing a new lettuce disease was isolated.

Since the close of the year L. H. Bailey resigned the directorship.

Bulletins 315 to 329 and 331, Circulars 12 to 16, and the Annual Report for 1912 were received from this station during the year.

The character of its research work and the attention given to many problems involved in different phases of agriculture, supported by its prosperous condition, make of the Cornell station a powerful agency for the solution of questions directly benefiting the farmers of the State and in many cases the Commonwealth as a whole.

New York Agricultural Experiment Station, Geneva.

W. H. JORDAN, D. Sc., LL. D., *Director.*

The principal subjects studied by this station the past year included cost of milk production, the chemistry and bacteriology of the processes involved in cheese making and cheese ripening, the number of body cells in milk, feeding and breeding poultry, the development of a new agar medium for the study of soil bacteria, liming and changes in temperature as affecting the soil flora, plant diseases and remedial and preventive measures, the life history and method of combating orchard and garden insects, orchard and small-fruit management, and the culture of field crops, including alfalfa.

The investigations under the Adams Act proceeded satisfactorily and several bulletins were published relative to the phosphorus compounds in various grains and other products, and to the metabolism and physiological effect of certain ash compounds fed to animals. Oats and corn were found to yield a crystalline body, apparently identical with the phytinlike substance determined in cottonseed meal and previously reported. A technical study of the composition and properties of some casein and paracasein compounds and their relation to cheese was made, and methods of preparing the substances for investigation were worked out.

A number of important results were reported from work under Hatch and other funds. The study of barn operations proved quite clearly that vacuum cleaners and other similar requirements are of minor effect as determined by the germ content of the milk. An examination of 1,230 samples of milk direct from the udders of 78 cows was reported as giving an average germ content of 428 per cubic centimeter.

The value of tar pads for the protection of early cabbage from the cabbage maggot was shown by the work of the year, and valuable results were also secured in the control of the cabbage aphid by spraying, while work with the tree cricket indicated the harmfulness of this insect as a carrier of apple diseases. As shown by field and laboratory results, the polysulphids of the alkaline earths possess marked insecticidal properties.

The State appropriated \$5,000 for two years for the study of a disease injurious in New York hopyards and provided for the study of fruit diseases in different parts of the State. A new orchard of 50 acres was acquired to carry on tests with new fruits, pruning, and stocks for cherries and plums.

Bulletins 349 to 363, Technical Bulletins 20 to 29, Circulars 20 to 24, and the Annual Report for 1911 were received from this station during the year.

Efficiency in administration and the standard of its work in research and experimentation have given to the New York State station the confidence of the agricultural public and the support of the State as a whole.

NORTH CAROLINA.

North Carolina Agricultural Experiment Station, West Raleigh.

B. W. KILGORE, M. S., *Director.*

The past year at the North Carolina station was devoted mainly to the reorganization of some lines of work under the consolidation of the college and State stations, and to the conduct of experiments under way. Studies were made of plant diseases, principally of the apple, ammonification and nitrification in soils, self-sterility in blackberries, dewberries, and Muscadine grapes, toxicity of cottonseed meal in animal feeding and of the life history of the corn billbug and the gloomy scale. Investigations were also conducted in plant breeding, with special reference to the transmission of characters in cotton, wheat, and *Rotundifolia* grape hybrids. Tests were carried on with varieties of wheat, oats, cowpeas, and soy beans, feeding experiments with cottonseed meal in rations for horses, mules, steers, and swine, and grazing experiments with hogs on different forage crops. Observations were made on self-sterility, self-fertility, and seedlessness in the persimmon, and on different methods of pruning the apple. Fertilizer experiments were extended during the year to some of the branch stations, and were enlarged to include comparisons of productiveness in different varieties of corn and cotton on soils of varying fertility.

The results secured in the Adams fund work of the station included data furnishing further evidence of the close relation between the fertility of the soil and the tendency of the corn plant to form suckers. Data were obtained on the toxicity of cottonseed meal indicating that iron salts reduced, if not entirely eliminated, the toxic properties of the meal when fed to small animals and to hogs. The life history studies of *Sphenophorus callosus* and *Chrysomphalus tenebriosus* were about completed during the year.

Under Hatch and State funds the work in animal husbandry was extended to include mainly beef production, sheep and hog raising, curing meat, and growing farm work stock. Among other results, a method of propagating the pecan by means of patch-budding seedling trees was successfully worked out. In a variety test of cotton 15 long-staple varieties gave an average of 264.5 pounds of lint and 509 pounds of seed and 54 short-staple varieties 304 pounds of lint and 495 pounds of seed per acre.

Buildings to the value of about \$3,500 were erected at the station during the year and a branch station with 250 acres of land was established near Oxford for work mainly with tobacco.

Bulletins 222 and 223 and the Annual Report for 1912 were received from this station during the year.

The North Carolina station pursues many important lines of work of value to the entire State, and under the new organization is extending its activities into wider fields of agricultural endeavor.

NORTH DAKOTA.

North Dakota Agricultural Experiment Station, *Agricultural College.*

J. H. WORST, LL. D., *Director.*

The work of the North Dakota station during the past fiscal year was conducted principally along the lines of agronomy, animal husbandry, soil sanitation, crop chemistry, and veterinary medicine. Studies were made of rotation effects of individual crops, methods of tillage and fertilizer treatment, root systems of plants, and of the improvement of crops. Data on the cost of milk and butter production were obtained, and feeding experiments with lambs, hogs, and poultry were pursued. Problems in farm management and agricultural engineering were given attention and breeding experiments with flax were in progress. Other activities included milling and baking tests, sugar-beet experiments, production of soy-bean oil, work on swamp fever and hog cholera, observations on insect injury and its prevention, and the testing of new varieties and pedigreed strains of fruits.

Eight Adams fund projects were in force during the year. A strain of flax with high wilt resistance has been produced and a cropping system to minimize the injury caused by flax wilt has been worked out. The results of applying similar methods to wheat indicated that sanitary methods of soil culture and of seed treatment will also be effective when applied to seed wheat and to soils rendered unproductive for wheat mainly through continued culture of the crop.

The importance of nonclinical infection carriers as factors in the maintenance of swamp fever infection foci was definitely established

and the tenacity of swamp-fever virus in infection carriers was demonstrated.

Experimental work was also conducted with Hatch and State funds by the various station divisions. Progress was made in working out a practical method for the diagnosis of chicken tuberculosis by tuberculin, and other results secured indicated that climate and soil are important factors in determining the oil content of flaxseed, and that by selection and breeding the oil content may be materially improved. The method of distributing purebred seeds was changed to a form of cooperation in which the station directs to a certain extent the manner of production, and later, under the State seed law, standardizes the product and assures its quality and identity to subsequent buyers through a method of sealing and certification. Through the efforts of the station the seed-inspection law was modified to give better control of the situation. An investigation of the distribution of prussic acid in different parts of the flax plant established the occurrence of considerable but variable amounts of the poison.

State appropriations benefiting the station included \$30,000 for a dairy barn, which was completed, \$5,000 for a dairy herd, \$5,000 for four substations, and \$12,000 for 24 demonstration farms. From private sources \$15,500 was received for work on linseed oil and paints.

Bulletins 97 to 102 and 104, Special Food Bulletins, volume 2, Nos. 6 to 11, the Annual Report for 1911, parts 1 and 2, and Annual Reports of the Williston substation for 1910, 1911, and 1912 were received from this station during the year.

The North Dakota station is generally progressive in its work, and some of the problems dealt with are of such a fundamental nature that their solution is of the highest importance within the State as well as elsewhere.

OHIO.

Ohio Agricultural Experiment Station, Wooster.

C. E. THORNE, M. S. A., *Director.*

The Ohio station during the year ended June 30, 1913, pursued many different lines of work, including principally culture, variety, and fertilizer tests with field, orchard, and garden crops, studies of plant diseases and their control, of the action of phosphorus and lime in the soil, and of the sulphur requirements of crops, feeding trials with beef and dairy cattle, sheep, swine, and poultry, investigations in tobacco breeding, the improvement of vegetables and of mineral metabolism in swine, and life history and control studies of bark beetles, shade, forest, and orchard tree pests, mill and granary

insects, and grasshoppers. Studies were also made of soil types and their fertility, together with soil aeration and nitrification, and work was followed in forest planting and management and the use and growth of ornamentals.

The Adams fund work of the station resulted in the accumulation of considerable data. In connection with work on the rôle of lime and phosphorus in maintaining soil fertility it was found that raw phosphate rock proved less efficient than acid phosphate when given as a top-dressing. Results of metabolism experiments indicated, among other things, that rations characterized by diversity of origin are most likely to contain in sufficient quantity all mineral nutrients required by animals.

The work conducted by Hatch and other funds was very extensive. A study of the cob rot of corn demonstrated the disease to be due to *Coniosporium gecevi*, which was found to be saprophytic in habit, attacking the ears of corn after growth had ceased. For dressing the wounds due to pruning gas tar proved best of all materials tested. Results of spraying experiments pointed out the necessity of an application just before the opening of the blossoms in the control of apple scab. Data secured from the limed plats showed a loss of 80 to 90 per cent in the lime applied in the 5-year period, the residual lime being confined to the upper 6 inches of soil. Feeding experiments with beef-breeding cows indicated the economic value of the generous feeding of silage.

The State continued its liberal support of the station. Steps were taken toward the purchase of a 200-acre farm for extending the station's work. A new wing, costing about \$10,000, was added to the administration building to supply office and laboratory space, and a building was also erected for use in animal nutrition work.

Bulletins 233, 239 to 248, 250 to 252, and 256 to 258 and Circulars 124 and 128 to 133 were received from this station during the year.

The Ohio station continues to grow with the agricultural importance of the State. Its organization and support enables it to enter upon newer and wider fields of effort as the demands arise.

OKLAHOMA.

Oklahoma Agricultural Experiment Station, Stillwater.

L. L. LEWIS, *Acting Director.*

During the past year the Oklahoma station gave attention principally to life history and control work of poultry vermin and orchard and field pests, including the alfalfa webworm, corn leaf-louse, and cowpea aphid, the reproduction of bees, stock poisoning through the feeding of cornstalks and sorghum, the culture of field crops, mainly

those used for forage, and to orchard and small fruits adapted to the State. Studies were also made of breeding and feeding sheep and of the quality and character of the wool as influenced by different factors. The manufacture and distribution of blackleg vaccine and hog-cholera serum and the inspection of creamery glassware and of nurseries and nursery stock was conducted under State provision.

In the Adams fund work of the station preliminary results were secured. The study of the influence of highly nitrogenous rations on poultry breeding stock showed no special effect from the use of such feed on the fertility of the eggs, while male hogs fed similar rations became nearly sterile. Incidental to the sheep-breeding work it was observed that the use of Kafir-corn silage and cottonseed meal reduced the cost of maintenance of breeding ewes about half, as compared with alfalfa hay and corn chop. Data were obtained showing that weakness of pollen is an important factor in the setting of fruit on tomatoes. In pursuing breeding work with sorghums for drought resistance it was noted that Kafir and Indian corn wilted at about the same moisture content of the soil, but that the capacity of revival was greater in Kafir corn.

A number of lines of work were carried on with the Hatch fund and those reported upon were mainly in entomology and dairy husbandry. Observations on the cotton and melon aphid demonstrated that in cucurbit fields this insect can be controlled by spraying with one part Blackleaf 40 in 900 parts of water. Feeding experiments with dairy cows indicated a higher feeding value for Bermuda grass than for prairie pasture. Cottonseed meal fed with alfalfa, stover silage, wheat bran, and corn chop reduced the cost of the ration per gallon of milk produced. In Bermuda grass breeding about five distinct types have now been established.

The State legislature made a biennial appropriation of \$15,000 for the station, of which \$5,000 is available the first year and \$10,000 the second year.

Bulletin 98 and the Annual Report for 1912 were received from this station during the year.

While the Oklahoma station made general progress in the improvement of conditions during the year, it has continued to suffer from interference with its administration and to be the subject of inconsiderate action. Until a liberal and settled policy is adopted toward the station which will recognize its administrative and its technical needs its condition can not be considered satisfactory and its funds can not be used in a way to give the return which should be expected from them.

OREGON.

Oregon Experiment Station, *Corvallis*.

JAMES WITTHYCOMBE, M. Agr., *Director*.

The Oregon station during the past year centered its energies on the pursuit of studies bearing mainly on pollination of the apple, varieties and improvement of orchard and small fruits, together with nuts and vegetables, fruit-juice preparation, orchard irrigation and cover crops, diseases of orchard fruits, harmful and beneficial insects, insecticides and fungicides, the action of soil bacteria, feeding swine and dairy cows, breeding sheep, field-crop breeding and rotation, and incubating and breeding poultry. The station was also in charge of the fertilizer control work.

Very satisfactory progress was reported in the Adams fund investigations in horticulture. It was found that there was more stability among the buds borne on spurs which had already borne fruit than among buds that are forming on young wood which had not borne fruit. This work was partly reported upon during the year. Investigations on apple anthracnose indicated the disease to be due to a hitherto unnamed fungus for which the name *Neofabræa malicorticis* is proposed. The perfect stage of the fungus was also found on the pear. The results of work on gummosis of the cherry indicated that the disease as observed in the blighting and gumming of the buds and spurs of ordinary varieties of sweet cherries may be due to a bacterium (*Pseudomonas cerasus*).

A large amount of work was done with Hatch and other funds at the station and also at the substations. Corn-breeding work has resulted in two promising varieties, one adapted for silage purposes and the other for feeding on the stalk. Experiments in evaporating loganberries pointed out a close relation between weight and quality of product and the condition in which the berries go into the evaporator. Hard ripe berries, picked before 10 a. m., which determines their condition, and dried for 16 hours, beginning at about 130° and finishing at 150° F., produced the best product. The best aroma and flavor was secured from berries fully ripe, and these also gave the largest percentage of juice and the highest sugar content.

A new station farm of 115 acres was prepared for work in animal husbandry, poultry husbandry, and horticulture. The State provided for extension and demonstration work in agriculture and appropriated to the college \$15,000 annually for the study of horticultural problems.

Bulletins 112 to 114, Research Bulletin 1, Circular 20, and the Biennial Crop Pest and Horticultural Report for 1911-12 were received from this station during the year.

The rapid growth and improvement of the work of the Oregon station continued during the year as a result of the greater efficiency afforded by improved buildings and equipment, a larger staff, and increased State funds.

PENNSYLVANIA.

The Pennsylvania State College Agricultural Experiment Station, State College.

R. L. WATTS, B. Agr., M. S., *Director.*

During the past year the Pennsylvania station gave consideration principally to varietal and cultural tests and breeding work with field crops, the efficiency of different forms of lime, the action of various fertilizer and manurial treatments, the correction of soil acidity, and the study of the soil flora. Other work included feeding experiments with cows, ewes, steers, and poultry, stabling cows and producing clean milk, studies of the collar rot of apples and other plant diseases, and of the effect of soot and smoke on plant life. In addition to testing and improving fruit and garden crops the horticulturist conducted fertilizer, culture, cover-crop, and spraying work in orchards, and the forester gave attention to forest nursery practice, basket-willow culture, and seed storage and fertility.

Among the results secured in the Adams fund work may be mentioned the marked uniformity in the amount of ammonium salts developed upon the same culture medium by the action of bacteria from uniform weights of soil from different plats in the long-term fertilizer experiments. As the number of bacteria in the different soils during the growing season was found to vary greatly, this indicated the action of some factor other than the number of bacteria as instrumental in bringing about the result. It is also reported that in general some of these soils sampled in a frozen state and then used as inoculants under normal temperature conditions for bacteriological development gave rise to as many if not more colonies than appeared when the samples were taken from the same soil during the summer months.

A large amount of work was in progress under Hatch and other funds. A study of the variations and Mendelian segregation of characters in the F_2 generation of tomatoes proved that red was dominant over yellow, and further showed that none of the descendants had reverted to the parent types. In work with asparagus, the use of large crowns produced gains of more than 50 per cent as compared with planting small crowns.

Tests with potatoes indicated that cyanamid was not as favorable a source of nitrogen as nitrate of soda, although giving about equally good results when used for oats. Pot tests with clover on acid soils showed that pulverized raw limestone was just as prompt and effec-

tive in correcting soil acidity and promoting the growth of clover as equivalent amounts of burnt or caustic lime. It was also found that red clover was tolerant of soil acidity up to a point requiring 1,500 pounds of calcium oxid per acre to render the upper 7 inches of soil neutral.

State appropriations of direct interest to the station included \$75,000 for completing the horticultural building, \$20,000 for a dairy barn, and \$6,000 for tobacco experiments.

Bulletins 117 to 121 and the Annual Report for 1911 were received from this station during the year.

The Pennsylvania station is making advance in the solution of many important agricultural problems of the State. The experimental work of the station, conducted on a project basis, continues to have a wide range.

The Pennsylvania State College Institute of Animal Nutrition, State College.

H. P. ARMSBY, Ph. D., LL. D., *Director.*

The principal work of the Institute of Animal Nutrition during the past year was a continuation of the study of the energy values of feeding stuffs, and in particular an experiment designed to compare the energy value of a pure nutrient (starch) with the figures reported by Kellner. Investigations were also conducted on methods of drying urine for analysis, the alkali excretion by cattle, and the electrical measurement of the body temperature of the experimental animal.

The results of the 57 experiments made with the respiration calorimeter up to the year 1909 were compiled with reference to their bearing upon the question of the source of animal heat in cattle. In the aggregate of these experiments, made upon 7 different animals and covering 114 days, the measured heat production was found to differ from that computed from the body metabolism by +0.4 per cent, thus showing that the energy transformations in cattle are governed by the same equivalencies which have been shown to obtain in man and in the dog, as well as in lifeless matter.

The principal improvement made during the year consisted in the installation in connection with the respiration calorimeter of an apparatus for automatically recording every 20 seconds the temperature differences between the ingoing and outcoming water.

The Institute of Animal Nutrition stands in a class by itself as a research agency. The application of its contributions to knowledge in its particular field can not fail ultimately to have great economic results.

PORTO RICO.

Porto Rico Agricultural Experiment Station, Mayaguez.

D. W. MAY, M. Agr., *Special Agent in Charge.*

The Porto Rico station, among various other lines of endeavor, gave special attention to the utilization of waste lands. In the campaign inaugurated to bring these lands back to profitable cultivation, the station distributes, to those who will follow directions, seeds, plants, and trees, and especially leguminous seeds for the production of forage and the renovation of the soil.

The chemical department of the station conducted experiments on the fertilizer requirements of various soils and crops. The work on the influence of fertilizers on the yield, quality, and shipping character of citrus fruits was carried on in cooperation with various growers. An extensive study of the red-clay soils of Porto Rico was completed and fertilizer experiments with coconuts and an investigation of chlorosis of pineapples, sugar cane, and other plants were in progress.

Efforts were continued to aid in the development of the citrus industry of the island and much attention was given to better methods of cultivation and fertilization of the coffee crop. A number of excellent varieties of coffee introduced by the station were found to yield more abundantly than the ordinary varieties. The results of experiments with vanilla seemed to have assured the growth of this crop as a new industry in Porto Rico. Experiments in growing and tapping rubber trees were in progress.

Investigations of banana disease causing so much loss elsewhere have shown that with proper methods bananas can be grown for a number of years on the same land without serious depreciation in the crop. Data secured in the study of gummosis of citrus trees indicated that at least some of the suspected fertilizers are without effect in producing the disease.

The live-stock work consisted largely in the introduction and breeding of poultry, horses, and cattle. A study was made of the stock industry of the island with special reference to soil types, to determine what influence limestone soils have on stock development. Some of the lately introduced grasses and other forage plants appeared very promising. The station's experiments with bees have been instrumental in establishing beekeeping as an industry.

Bulletin 12, Circulars 14 and 15, and the Annual Report for 1911 were received from this station during the year.

RHODE ISLAND.

Rhode Island Agricultural Experiment Station, Kingston.

B. L. HARTWELL, Ph. D., *Director.*

The work of the Rhode Island station during the year included principally investigations on poultry diseases and immunity to fowl cholera, inheritance in fowls and rabbits, bacterial infection of fresh eggs, availability of phosphorus in relation to crop production, and the effect of sodium on the composition of plants, together with studies relating to the influence of certain crops on those following in the rotation, the use of green manures, the availability of plant-food elements in different forms, and the feeding of chicks. Experiments were also carried on with crop rotations and cover crops and with various fertilizers, more especially nitrate of soda and different grades and kinds of lime. The inspection of feeding stuffs and fertilizers was carried on with State funds.

The Adams fund work at the station was actively prosecuted and some of the results were published. The study of blackhead in turkeys indicated that the beneficial effect of feeding sour milk does not lie in the curd alone. Among 10 different strains of the fowl-cholera bacterium investigated for their resistance-producing power, one was discovered capable of producing perfect immunity in rabbits to highly virulent cultures. In the study of inheritance in fowls, a completely barred pattern was secured in the F_2 generation and a pure strain of barred fowls was built up from these individuals. The evidence was plain that this character had its origin in a factor for barring in the original stock.

A large amount of Hatch fund work was also in progress. Results secured with cover crops showed that crimson clover used in this way with the continuous culture of corn was more beneficial than rye. Cooperative experiments in alfalfa culture demonstrated the value of liming and inoculating the soil. In fertilizer experiments, rye grew equally well upon limed plats receiving sulphate of ammonia and on plats limed and unlimed receiving nitrate of soda, but clover seeded with it failed on even the nitrate of soda plat without lime, and neither rye nor clover grew on the unlimed plat treated with sulphate of ammonia. It was also observed that mixing fresh cow dung and floats together for a number of months before application gave practically no increase in available phosphoric acid.

Bulletins 150 to 154 and Inspection Bulletins for July, 1910, November, 1910, April, 1911, June, 1911, June, 1912, September, 1912, and October, 1912, were received from this station during the year.

The Rhode Island station continues to pursue a large amount of work in a thorough and a systematic manner, and the character of these studies is well worthy of the support and assistance of the State.

SOUTH CAROLINA.

South Carolina Agricultural Experiment Station, *Clemson College.*

J. N. HARPER, B. S., M. Agr., *Director.*

The work of the South Carolina station was vigorously prosecuted during the past year, attention being particularly given to self-sterility in *Rotundifolia* grapes, the cotton root-louse, wireworm, gloomy scale, and other insects, plant diseases, principally anthracnose and wilt of cotton, the mixing of fertilizers as related to the solubility of the potash, the lime content of basic slag and Thomas phosphate, the effect of feeding cottonseed meal to cows and hogs, and rotation, fertilization, and varieties of different field crops, including those grown as forage and cover crops. The feeding stuffs and fertilizer inspections were conducted under State provision, and other work was done in connection with the State Crop Pest Commission.

Satisfactory progress was made in the work under the Adams fund. The study of the biology of wireworms determined the species and their relative importance, *Horistonotus uhleri*, followed by *Monocrepidius vespertinus*, being the most injurious. It was found that these insects lay their eggs in June and July and that the adult weevils require loose soil for oviposition. Studies of the cause of partial insolubility in water of potash salts when mixed with basic slag seemed to indicate that the potash combines with the lime and iron in the slag and thus forms insoluble compounds. In experiments connected with the cotton anthracnose investigation, seed taken from healthy stocks continued to produce disease-free progeny.

In addition to the Adams fund projects a number of problems were studied under Hatch and State funds. Among other lines of work the horticulturist made a successful culture test with dasheens, securing a yield at the rate of 378 bushels per acre, and distributed seed from an exceedingly productive variety of okra perfected at the station. Work on the cotton root-louse in the eastern part of the State indicated that the use of repellents gave no relief, while the best method of control for that region seemed to be a three-year rotation with a good crop on infested lands during the winter. Fumigation experiments with carbon dioxid against insects attacking corn stored in granaries gave results directly dependent on the tightness of the storage compartment. The results were further in favor of a temperature of about 75° F. The work at the substation at Florence was organized to supplement in that section the lines of work at the main station.

Bulletins 167 to 171, Circulars 6 to 10, and the Annual Report for 1912 were received from this station during the year.

The South Carolina station fills an important place in the improvement and development of agriculture in the State, and its work is much appreciated, as is shown by the demand for its extension.

SOUTH DAKOTA.

South Dakota Agricultural Experiment Station, Brookings.

J. W. WILSON, M. S. A., *Director.*

During the past year the activities of the South Dakota station embraced mainly corn, breeding and rotation experiments, comparisons of grain and live-stock farming, adaptation of alfalfa to semi-arid sections, the breeding of fruits, sugar-beet seed production, studies of the effect of unbalanced rations on horses and of the use of alkali water on dairy cows, observations on the efficiency of the milking machine, feeding tests with lambs and steers, and an investigation of lumpy jaw.

Considerable progress was made during the year in the six Adams fund projects in hand. Studies on plant-food problems indicated that nitrogen and phosphoric acid are limiting elements in the soils under investigation. Plant-breeding work pointed to an apparent relation of both yield and maturity in corn to the height of the ear on the stalk. The use of alkali waters apparently did not affect the health of dairy cows. In connection with the plant-breeding investigations of the horticulturist, a plum of good size, attractive color, and a desirable flavor was developed.

With the Hatch and sales funds a considerable amount of experimental work, particularly in agronomy, horticulture, and animal husbandry, was maintained. The breeding of sugar beets for seed production demonstrated that seed of high quality can be grown. Experiments with potatoes gave an increase in yield of 28 per cent in favor of large tubers as compared with small tubers used for seed. Corn silage as a sole ration for lambs did not prove profitable, while the new Siberian alfalfa stood second only in value to common alfalfa when fed with grain. With the addition of oil meal, corn silage was found to be a cheap and profitable feed for fattening steers.

The State appropriated \$25,000 for the introduction and distribution of alfalfa, \$7,000 for additions to station buildings, and \$16,000 for substations.

Bulletins 136 to 141 were received from this station during the year.

The South Dakota station made considerable progress during the year in the improvement of its equipment and in the extension of the experimental work, mainly in field-crop culture in the drier parts of the State.

TENNESSEE.

Tennessee Agricultural Experiment Station, Knoxville.

H. A. MORGAN, B. S. A., *Director*.

The activities of the Tennessee station the past year included mainly studies relating to the humus and lime content of soils, disease resistance in clovers, apples, pears, and tomatoes, diseases of hogs, horses, and mules, plant breeding and improvement, the biology of the cattle tick, and the life history of the hog louse and the peach-tree borer. Experiments were also conducted on the use of green manures, especially cowpeas, the value of Rhodes and Sudan grasses, crop rotation as relating to land improvement and to beef production, the use of different forage crops for hogs, summer pruning of peaches, root development of apple trees, building up of trucking soils, and the control of insect pests in orchards. Inspection work in different lines was carried on as provided for by State laws.

Satisfactory progress was reported in the Adams fund work of the station. In connection with a study of factors influencing the lime requirements of soils, it may be found that the lime and magnesia ratio of 1 to 3 did not seem especially beneficial in growing wheat. Work with pure cultures of *Bacillus subtilis* and *B. proteus vulgaris*, organisms which enter into humus formation, showed a much larger quantity of humus produced when these organisms acted in conjunction with each other than when each was active by itself. The investigation on disease resistance in clovers showed that plants from seeds of resistant strains continued to offer a marked resistance to *Colletotrichum trifolii*. In studying Fusarium wilt of tomatoes it was noted that crop rotation is a very important factor in any method of control.

Work conducted under Hatch and other funds brought out, among other results, that the favorable effect of turning under cowpeas was very apparent in growing wheat, and that soy beans gave a marked increase in the value of a rotation of forage crops as measured by beef production. Studies of the San José scale determined the existence of at least five broods under Tennessee conditions. Chemical analyses of Tennessee uplands showed a low content of calcium oxid, the range being from 2,226 to 9,695 pounds per acre for the upper foot of soil.

For the year the State appropriated \$10,000 for the western Tennessee substation and \$5,000 for the central Tennessee substation.

Bulletins 96 to 99 and the Annual Report for 1910 were received from this station during the year.

The Tennessee station continues to pursue lines of scientific and practical work for the benefit of agriculture in the different parts of the State, and to draw into closer relationship with the farmer.

TEXAS.

Texas Agricultural Experiment Station, College Station.

B. YOUNGBLOOD, M. S., *Director*.

The lines of work in progress at the Texas station during the year ended June 30, 1913, related principally to swamp fever, biological properties of the soil, composition, and digestibility of feeding stuffs, plant breeding of cotton and small fruits, inheritance in bees, plant diseases, and insect pests. Attention was also given to hardiness and productivity of the peach, feeding trials with sheep and steers, experiments in sheep breeding, culture, variety, and rotation tests with field and pasture crops, and to determination of the value of cottonseed meal as food for man. Under State provision 600 samples of fertilizers and 1,400 samples of feeding stuffs were analyzed.

The investigations under the Adams fund, which were in part reported upon during the year showed, among other facts, that soils contain small quantities of ether extract and chloroform extract corresponding to those found in plants. In connection with digestion experiments it was found that the ether extract of hays and fodders contains a large percentage of high alcohols which are not as readily digested as the foods which accompany them. Incidental to a study of inheritance in cotton, several hybrids intermediate in earliness and as prolific as the upland strains have been secured.

With Hatch and other funds a large amount of work was under way, and some of the results were published. The chemist found that the heating of corn chops is due to an excess of moisture and may be prevented by drying the corn. Feeding tests with steers were conducted, showing that silage with cottonseed meal was more profitable than rations in which the silage was partly or wholly replaced by cottonseed hulls. In crossing the more common breeds with caracul sheep vigorous lambs with a very good quality of fur were obtained in the first cross. Work with field crops showed highest yields of corn when planted at the rate of a single plant per square yard. Pasture improvement work gave good results from mixtures of rescue grass, bur clover, and Bermuda grass, and indicated a possible increase in pasture value by the use of Japan clover.

Bulletins 147 to 154 were received from this station during the year.

The Texas station enjoyed steady development during the year and pursued its different projects along definite plans. The station together with the State stations is rendering greater service to the farmers of the State than ever before.

UTAH.

Agricultural Experiment Station, Logan.

E. D. BALL, Ph. D., *Director*.

The Utah station carried on investigations principally in poultry breeding, on the behavior and effect of arsenical compounds in soils and plants, the content and movement of nitrates in certain soils, and the life history of several predaceous insects, and conducted studies of breeding sugar beets, potatoes, and alfalfa, loss in conservation of soil moisture, the limiting effect of alkali salts, methods of pruning, orchard irrigation, control of insect and nematodes, dry farming practices, and the feeding of dairy cows.

In the Adams fund work the results of the poultry breeding experiments are thought to indicate that very little correlation exists between the actual laying capacity as measured by a three-year record of a hen and the record of any single year. In studying the sugar-beet insect causing blight, it was found that the disease may be reduced by early irrigation to force a dense leaf growth, and by early planting of the crop. The study of the effect of arsenical sprays on the life of orchard trees was completed up to the publication of results. The investigation on the effect of soluble arsenic absorbed by plants indicated that arsenical sprays up to a certain point increased nitrification and ammonification, while beyond it they decreased these processes. In studying the nature of organic compounds of arid soils, some plastic aluminum compounds were discovered which appeared to play a part in the plasticity of clay. The work on the life history of the alfalfa weevil was about brought to completion during the year.

Methods for the control of the alfalfa weevil perfected under Hatch and State funds include spring cultivation, the use of the brush drag, suitable crop rotation, and clean culture. A study of Utah dry-farm soils completed during the year showed that most of these soils have sufficient potassium and phosphorus, but that they are in need of organic matter to supply nitrogen and to aid in the liberation of plant food. The results of a series of experiments with different quantities of irrigation water, showing the influence on the production of dry matter, yield, efficiency of water applied, and on the growth and composition of plants at different stages of development, were published during the year.

A number of changes occurred on the staff of the station, and the extension work was organized as a separate department of the college of agriculture, by which a clearer differentiation between station and extension work was made possible. Work was conducted on dry farming, irrigation, and the alfalfa weevil with a State appropriation of \$15,000.

Bulletins 115 to 122 and Circulars 6 to 11 were received from this station during the year.

The good condition and gratifying outlook of the Utah station, which has resulted largely from the efficiency of its staff, have won for it the support and sympathy of Utah farmers.

VERMONT.

Vermont Agricultural Experiment Station, *Burlington*.

J. L. HILLS, Sc. D., *Director*.

The investigations carried on by the Vermont station the past year had a bearing mainly on the effect of fungicides on host plants, the life history of potato scab and immunity to the disease, the nutritive value of milk, the storage of carbohydrates in certain species of trees, the forcing of plants, the effect of different amounts of protein in animal feeding, the maintenance of dairy cows, and the organisms causing the damping off of coniferous seedlings. Other activities included studies of club root of cruciferous plants and of infectious abortion in cattle, and experiments in the establishment of methods for the determination of organic nitrogen in fertilizers, the use of scions when grafted on different apple stocks, and the successful keeping of apples in storage. Observations were also made on the yielding capacity of squashes and the growth of different hardwoods. The police work of the station, including inspection of feeding stuffs and fertilizers, was carried on under State provision.

General progress was reported in the Adams fund work of the station. In the investigation of the effect of Bordeaux mixture on plants, preliminary work seemed to show a stimulating effect on potatoes from the use of this fungicide, and a greater resistance of the chlorophyll to environmental characters. It was also found in other studies with Bordeaux mixture that the addition of sugar or glucose will cause the solution to retain its chemical and physical properties much longer than ordinarily. Results secured in the study of carbohydrate storage in various species of trees indicated that the storage of food materials soluble in water increases as cold approaches, reaching its maximum during the coldest period of winter.

A number of lines of work were conducted with the Hatch fund and some of the results secured were made public. Experiments with methylene blue as a remedy for infectious abortion in cattle gave encouraging results. A study of seed potatoes indicated that northern-grown seed is superior to that grown in the South, and that the effect of one year's removal from northern conditions is generally noticeable. After the first year the decline in yield was quite rapid, while seed produced in the South but grown under northern conditions showed improvement. The process of ensiling was found to destroy

the viability of weed seeds. Cultural studies on the Montreal Market muskmelon demonstrated the possibility of its successful culture in Vermont, and indicated the existence of at least two distinct types.

Bulletins 161 to 167 and the Annual Report for 1912 were received from this station during the year.

The Vermont station continues to apply itself to the problems of agricultural production within the State, and is helping to make farming a safer and more profitable undertaking.

VIRGINIA.

Virginia Agricultural Experiment Station, Blacksburg.

S. W. FLETCHER, Ph. D., *Director.*

The principal lines of work receiving attention at the Virginia station the past year included studies of soil environment as affecting fruit-bud formation, of temperature as related to the blossoming of fruits, and of improvement by breeding of apples and vegetables, experiments in soil and pasture management, crop rotation, the use of fertilizers and green manures, the improvement of field crops, the testing of seeds and the eradication of weeds, investigation of the protein and energy requirements for milk production, the relation of parasitic fungi and bacteria to their host plants and other phases of plant pathology, the fixation of phosphoric acid in soils and of nitrogen by nitrogen-gathering organisms of the soil, and inoculation for the culture of leguminous crops. In addition, feeding tests were made with cattle and hogs, diseases of cattle and sheep were studied, and the chemical composition of certain crops was determined. The inspection work of the station was carried on with State funds.

The Adams fund work was systematically pursued and progress was reported. The study of the fixation of phosphoric acid in soils pointed, among other things, to the fact that Virginia soils are generally deficient in available phosphoric acid, while available potash is present in adequate quantities. In connection with plant pathological investigations, it was found that the juice of decayed apples is less suited to the growth of the organism causing bitter rot than the juice of sound apples having an equal content of sugar. It was found further that the average rate of assimilation of carbon dioxide by the apple leaves affected with cedar rust was only about half the rate in healthy leaves.

Work under the Hatch fund embraced the study of various topics, including inheritance in cabbage hybrids. It was ascertained that of the different characters studied, inheritance in the first generation was preponderant if not completely dominant, and it was concluded that permanent hybrids need only to be improved through pedigree selection to establish varieties. The results of experiments on the commercial value of dwarf apples indicated that these have little com-

mercial importance. Tests in seeding alfalfa showed that the use of 20 pounds of seed per acre was adequate. In a comparison of spray solutions, lime sulphur was the only one giving freedom from cedar rust in apple orchards without injury to the leaves.

Bulletins 199 to 201 were received from this station during the year.

The Virginia station made a good record during the year in both scientific and practical work. A number of changes in the station staff occurred during and since the close of the year, creating temporarily a period of uncertainty, which will detract from the efficiency of the station unless speedily corrected.

Virginia Truck Experiment Station, Norfolk.

T. C. JOHNSON, B. S. A., M. A., *Director*.

The Virginia truck station during the year ended June 30, 1913, devoted the major part of its energies to the solution of problems connected with plant breeding, the maintenance of soil fertility, and the control of plant diseases and insect pests. Results secured in work on soil fertility indicated that in the soils under test phosphoric acid was the limiting factor. Particular attention was given to the use of manurial treatment in growing kale and the results, among other things, showed the importance of the use of barnyard manure in connection with commercial fertilizers and of crimson clover as a green manure. In cooperation with the main station at Blacksburg, the study of climatic conditions as influencing the distribution of peach yellows was pursued.

The station officers assisted in conducting farmers' institutes and in carrying on demonstrations in the trucking regions of the State.

The station was maintained with an appropriation of \$5,000 from the State legislature and \$5,000 from the State board of agriculture, which also appropriated \$2,500 for a substation at Tasley, established for the study of local truck-crop problems.

The Virginia truck station continues to render valuable service to the trucking interests of the State through its cooperative, demonstration, and experimental work.

WASHINGTON.

Washington Agricultural Experiment Station, Pullman.

I. D. CARDIFF, Ph. D., *Director*.

Attention was devoted mainly during the past year to work in crop production, including breeding and other work with corn, wheat, oats, potatoes, and small fruits; experiments in orchard pollination and frost protection and with cover crops and varieties of vegetables; fertilizer tests in orchards and alfalfa fields; soil studies with regard to moisture content, bacterial activity, and nitrification;

observations on the water requirements of crops; investigation of fermentations in milk; work in plant pathology, particularly on tomato blight; and studies on endo-parasites and immunity of insects to insecticides.

Among the Adams fund investigations, work on the progressive development of the wheat kernel was completed and reported upon. In these experiments there was apparently no increase of nitrogen, phosphoric acid, and potash in the kernel after the water content of the plant had fallen to 40 per cent. The results further showed that the ratio of nitrogen to phosphoric acid, was constant for the variety. The study of sulphur as a plant nutrient indicated the need of this element for normal growth of wheat and its application in the form of sulphates as most effective. The pathological symptoms of red-water of cattle were studied as a preliminary step in the investigation of the disease, and a report on the work was issued. In studies of pernicious anemia of horses, the disease was produced by injections of blood of diseased animals, but not by similar use of filtered serum.

Considerable work with the Hatch and other funds was done during the year. The results of fertilizer experiments with alfalfa, showing gypsum especially effective, were ascribed to the sulphur rather than the lime in this substance. Wheat-smut spores, exposed on the surface of the ground, were found to have retained their germinative power for an entire year. In spraying experiments brought to completion the best results were secured with a nozzle producing a coarse penetrating spray and the use of a crook to direct the spray downward into the upward-pointing blossoms. Studies relating to the nitrogen and humus problem in dry farming were also completed, the results indicating how the nitrogen and humus supply of the soil under dry-farming conditions may be increased through crop residues plowed under, the growth of leguminous crops and their use for green manuring, and the application of barnyard manure.

Numerous changes on the staff during the year included the resignation of the directorship by R. W. Thatcher and the appointment of I. D. Cardiff to the vacancy. The board of regents voted \$150,000 for an agricultural building to be used jointly by the station and the college. The State appropriation for the station during the year was \$5,000.

Bulletins 105 to 110, Popular Bulletins 39 to 52, and Bulletins 7 to 9 (special series) were received from this station during the year.

Numerous changes in the staff of the Washington station during the year seriously interfered with many of its lines of work, but the progress made in its reorganization gave an assuring outlook for the efficient continuance of its important activities.

WEST VIRGINIA.

West Virginia Agricultural Experiment Station, Morgantown.

E. D. SANDERSON, B. S. A., *Director*.

The principal activities of the West Virginia station during the past fiscal year embraced experiments in the culture of alfalfa, the rejuvenation of orchards, methods of pruning as related to yield, the application of phosphorus and the feeding of cattle and sheep, studies of plant diseases, the control of the apple-tree and peach-tree borers, the use of the specific-gravity test in the selection of seed corn, temperature as related to insect life, and fixation of atmospheric nitrogen and of oxidation and acidity in soils, tests in spraying for the control of insects and plant diseases and of varieties of fruit, vegetable, and grain crops, including varieties of corn for grain and silage, and work in plant breeding with corn, potatoes, sweet potatoes, and strawberries. Studies were also made of the cost of producing eggs and broilers, the value of green feed for poultry in winter, and of factors influencing the fertility of eggs.

The Adams fund investigations were generally progressive, and some studies were completed and prepared for publication. In the investigation on the effect of pressure in the preservation of fruits, vegetables, and milk it was found that by high pressure repeated at intervals complete sterilization was secured. Studies of the relation of care and feeding to the vigor of germs in hens' eggs indicated that the heaviest eggs are produced when the fowls are laying most freely in the spring and that fowls fed a poorly balanced ration produced eggs low in weight.

The work supported by Hatch and other funds included, among different lines, fertilizer experiments with tomatoes which indicated that the soils studied as judged by the requirements of the tomato crop were deficient in phosphorus. The experiments in the rejuvenation of old and neglected orchards showed that for the first year the results were not always profitable, but that in all cases under experiment the crop secured the second season more than paid for all expenses.

The equipment of the station was improved and the staff increased during the year. The orchard and nursery inspection work previously carried on by the station was reorganized under the State Crop Pest Commission.

Bulletin 139 was received from this station during the year.

The work of the West Virginia station is being thoroughly organized and is commanding the interest and appreciation of the State, as evidenced by the increased appropriations for its support. The station is still handicapped by lack of sufficient suitable land.

WISCONSIN.

Agricultural Experiment Station of the University of Wisconsin, *Madison*.

H. L. RUSSELL, Ph. D., *Director*.

The investigations pursued by the Wisconsin station the past year comprised studies of hereditary factors in cattle, of the effects of continued inbreeding, diseases of cabbage, mineral nutrition of animals, nutrients from single plant sources and from different plants, the rôle of acid in Cheddar cheese making, the influence of soil treatment on the phosphorus content, experiments in plant and soil improvement, crop production, the control of insects and plant and animal diseases, and in feeding cows, sheep, and hogs. In dairying many lines of work were in progress and in agricultural economics a number of inquiries were pursued. In addition, the inspection and other police work of the station was conducted as provided for by the State.

The Adams fund investigations of the station were actively pursued and partly reported. The studies in Cheddar cheese making showed that a very uniform cheese of good quality can be made by the use of commercial acids and a starter in pasteurized milk. It was found in studying the influence of soil treatment on the phosphorus of soils that the addition of lime reduced the solubility of the soil phosphorus, and that the removal of the soluble phosphorus as formed greatly increased the quantity capable of being rendered soluble. The investigation on the mineral nutrients of animals indicated that variations in the supply of lime did not materially affect the fetus skeleton. It was observed that the excretion of lime increased with the bulkiness of the feed.

A larger amount of work than with the Adams fund was carried on with Hatch and other funds. Among the results obtained may be mentioned the marked beneficial effect of fertilizers supplying sulphur in growing cruciferous plants, the efficiency of steam sterilization of seed beds in checking tobacco diseases, and the failure of the tuberculin test in its present form for the detection of avian tuberculosis. On sandy and acid soils the application of phosphates and the growing of serradella and lupines were found to be very effective methods of improvement. Feeding corn silage to cows to supplement scant pastures proved to be more profitable than feeding soiling crops. Hemp was found profitable for fiber production and also very efficient as a weed eradicator, particularly of quack grass and Canada thistle.

Bulletins 221 to 229 and 231, Research Bulletins 24 to 28, and Circulars of Information 13 (revised) and 34 to 44 were received from this station during the year.

The Wisconsin station continues to develop its lines of research work and to give increased attention to the application of the results on the farms of the State.

WYOMING.

Wyoming Agricultural Experiment Station, *Laramie*.

H. G. KNIGHT, A. M., *Director*.

The activities of the Wyoming station for the year were mainly centered upon field, fertilizer, and rotation tests in agronomy, experiments with pasture and forage crops and maintenance and fattening rations for pigs, feeding and digestion trials with sheep, and feeding experiments with cattle in animal husbandry. Work was also in progress on the pathology and chemistry of vegetable poisons, the resistance of cement to the action of alkali, the relation of humus to bacterial life in the soil, the life history and eradication of parasites attacking sheep, and the effect of moisture on the strength of wool fiber.

Under the Adams fund, the wool investigations demonstrated that very dry or very moist wool is weaker than wool with medium moisture content, and that wool when moist is more elastic than when dry, thus showing the importance of this factor in testing for strength and elasticity. In the poisonous-plant investigations, the lethal doses of the poisonous principles were determined for different animals, and a study was made of methods of treatment and of the use of antidotes. Studies of the life history of the sheep tick were completed and the anatomy of the common tapeworm of sheep was quite fully worked out. A study on the action of alkali on cement showed that the high silica cements were most durable, while iron slag cements were no more resistant than ordinary kinds. Mortar cements disintegrated more rapidly than neat cements, and the use of a 2 per cent sulphuric-acid solution instead of water in mixing was found to retard disintegration.

Among different lines of work carried on with the Hatch fund, feeding experiments with pigs resulted in a requirement of 216 pounds less grain, or approximately 51 per cent per 100 pounds of gain when pea pasture replaced half the grain ration, as compared with 136 pounds less grain, or approximately 32 per cent, when rape pasture was similarly substituted. The results of an investigation to determine the relation of the amount of humus and the number of bacteria in the soil indicated that humus apparently exerted little or no influence in this connection.

Experimental work on the dry farm containing 640 acres was discontinued and the land prepared for other lines of study. The agronomy farm was improved, a concrete silo was constructed, and

one of the older buildings was converted into a dairy barn with modern equipment. An agricultural building in course of construction with an allowance of \$100,000 will afford office and laboratory facilities for all station departments.

Bulletins 93 to 98 and the Annual Report for 1912 were received from this station during the year.

Notable progress was made at the Wyoming station in better equipment and facilities for work and in raising the grade of investigation. The growth in general efficiency has been marked, and some of the results secured are distinct contributions to the fund of agricultural knowledge.

STATISTICS OF THE AGRICULTURAL EXPERIMENT STATIONS.

The total income of the experiment stations during 1913 was \$4,654,518.77. Of this amount \$720,000 was derived under the Hatch Act, \$720,000 under the Adams Act, \$1,807,016.51 from State appropriations, \$21,187.88 from individuals and communities, \$195,356.12 from fees, \$347,429 from farm products, and \$843,529.26 from miscellaneous sources. In addition, the Office of Experiment Stations had an appropriation of \$431,700 for the fiscal year, including \$30,000 each for experiment stations in Alaska, Hawaii, and Porto Rico, and \$15,000 for the Guam Experiment Station.

The value of the additions to the equipment of the stations was estimated as follows:

Buildings.....	\$395,136.81
Libraries.....	25,040.33
Apparatus.....	67,149.76
Farm implements.....	69,564.00
Live stock.....	123,138.27
Miscellaneous.....	51,400.32
Total.....	731,429.49

The stations employed 1,667 persons in the work of administration and inquiry. Of this number 779 were also members of the teaching staff of the college and 522 assisted in farmers' institutes. During the year the stations published 641 annual reports, bulletins, and circulars, aggregating 20,040 pages, and these were distributed to 1,010,668 addresses on regular mailing lists.

The detailed statistics of the stations by States are shown in the tables following.

General

	Station.	Location.	Director.	Date of original organization.	Date of organization under Hatch Act.
1	Alabama (College).....	Auburn.....	J. F. Duggar.....	Feb. —, 1883	Feb. 24, 1888
2	Alabama (Canebrake).....	Uniontown.....	L. H. Moore.....	Jan. 1, 1886	Apr. 1, 1888
3	Alabama.....	Tuskegee Institute.....	G. W. Carver.....	Feb. 15, 1897	.....
4	Alaska.....	Sitka.....	C. C. Georgeson.....	1898.....	.....
5	Arizona.....	Tucson.....	R. H. Forbes.....	.....	1889.....
6	Arkansas.....	Fayetteville.....	Martin Nelson.....	.....	1887.....
7	California.....	Berkeley.....	Thomas Forsyth Hunt.....	1875.....	Mar. —, 1888
8	Colorado.....	Fort Collins.....	C. P. Gillette.....	.....	Feb. 29, 1888
9	Connecticut (State).....	New Haven.....	E. H. Jenkins.....	Oct. 1, 1875	May 18, 1887
10	Connecticut (Storrs).....	Storrs.....	do.....	.....	May 18, 1887
11	Delaware.....	Newark.....	Harry Hayward.....	.....	Feb. 21, 1888
12	Florida.....	Gainesville.....	P. H. Rolfs.....	.....	1888.....
13	Georgia.....	Experiment.....	R. J. H. De Loach.....	Feb. 18, 1888	July 1, 1889
14	Guam.....	.....	John B. Thompson.....	July —, 1908	.....
15	Hawaii.....	Honolulu.....	E. V. Wilcox.....	1901.....	.....
16	Idaho.....	Moscow.....	W. L. Carlyle.....	.....	Feb. 26, 1892
17	Illinois.....	Urbana.....	Eugene Davenport.....	.....	Mar. 21, 1888
18	Indiana.....	Lafayette.....	Arthur Goss.....	1885.....	Jan. —, 1888

statistics, 1913.

Number on staff.	Number of teachers on staff.	Number of persons on staff who assist in farmers' institutes.	Publications during fiscal year 1913.		Number of names on mailing list.	Principal lines of work.	
			Number.	Pages.			
32	16	15	20	401	21,000	Field experiments; cooperative experiments with farmers; horticulture; plant breeding; soil improvement; feeding experiments; entomology; diseases of plants and animals; analyses of fertilizers.	1
1	-----	-----	-----	-----	(1)	Soil improvement; field experiments; plant breeding; diseases of plants.	2
20	18	18	2	42	1,700	Field experiments; horticultural; plant breeding; diseases of plants; animal industry; poultry investigations; dairying.	3
7	-----	-----	1	95	-----	Farm experiments; testing adaptability of cereals, vegetables, and forage plants; horticulture; plant breeding; stock breeding; cooperative work with settlers; agricultural survey.	4
13	3	9	4	236	7,000	Botany; field experiments; improvement of ranges; horticulture, including olive products and date-palm culture; sheep-breeding experiments; plant breeding; underground water development; dry farming; demonstration train.	5
16	15	12	8	110	16,000	Chemistry; soil physics; field experiments; horticulture; plant breeding; diseases of plants; animal husbandry and pathology; feeding and breeding experiments; entomology; nursery inspection; dairying; poultry experiments.	6
67	46	42	36	836	21,191	Chemistry; soils; bacteriology; fertilizer control; field experiments; horticulture, viticulture, and zymology; botany; meteorology; animal husbandry; entomology; dairying; poultry culture; drainage and irrigation; silviculture; reclamation of alkali lands; animal and plant pathology; nutrition investigations.	7
24	10	15	7	188	11,275	Chemistry; agronomy; horticulture; animal husbandry; horse breeding; animal diseases; poultry; potato diseases; alfalfa breeding; entomology; bacteriology; irrigation.	8
18	-----	5	4	703	9,500	Chemistry; analysis and inspection of fertilizers, foods, drugs, and feeding stuffs; inspection of Babcock-test apparatus; nurseries; apiaries; diseases of plants; plant selection and breeding; seed testing; forestry; field experiments; entomology; investigation of vegetable proteids.	9
14	7	7	2	59	10,000	Dairy and soil bacteriology; field experiments; horticulture; feeding and breeding experiments; poultry experiments and diseases; dairying, including soft-cheese manufacture; embryology.	10
15	8	4	5	244	8,500	Chemistry; field experiments; horticulture; diseases of plants and animals; animal husbandry.	11
17	-----	4	6	232	17,500	Chemistry; soils; field experiments; horticulture; plant physiology; diseases of plants; feeding experiments; entomology; plant breeding.	12
9	-----	-----	1	4	7,000	Chemistry; field experiments; bacteriology; horticulture; plant breeding; plant and animal diseases; entomology; feeding experiments; dairying.	13
3	-----	-----	1	35	(1)	Agronomy; veterinary science; animal breeding; apiculture; crop adaptation and improvement; horticulture; poultry.	14
9	-----	-----	11	282	(1)	Chemistry; soils; entomology; apiculture; horticulture; plant breeding; field experiments with tropical crops except sugar cane; forage crops; cooperative marketing; demonstration work.	15
29	12	12	5	228	5,000	Chemistry; bacteriology; botany; field experiments; horticulture; plant breeding; plant pathology, and diseases; animal husbandry; irrigation; dairying; dry farming; wheat investigations; soils and soil physics.	16
88	51	30	14	600	27,500	Soil chemistry; soil physics; bacteriology; pot and field experiments; horticulture; plant breeding; animal husbandry; diseases of plants and animals; dairying.	17
44	15	5	15	978	42,097	Chemistry; soils; field experiments; feeding experiments; horticulture; plant breeding; diseases of plants and animals; entomology; dairying; feeding stuff and fertilizer control; agricultural extension work.	18

¹ No data.

General statistics,

	Station.	Location.	Director.	Date of original organization.	Date of organization under Hatch Act.
19	Iowa.....	Ames.....	C. F. Curtiss.....	.....	Feb. 17, 1888
20	Kansas.....	Manhattan.....	W. M. Jardine.....	.....	Feb. 8, 1888
21	Kentucky.....	Lexington.....	J. H. Kastle.....	Sept. —, 1885	Apr. —, 1888
22	Louisiana (Rice).....	Crowley.....	W. R. Dodson.....	.....	.....
23	Louisiana (Sugar).....	New Orleans.....	do.....	Sept. —, 1885	}.....
24	Louisiana (State).....	Baton Rouge.....	do.....	Apr. —, 1886	
25	Louisiana (North).....	Calhoun.....	do.....	May —, 1887	
26	Maine.....	Orono.....	C. D. Woods.....	Mar. —, 1885	Oct. 1, 1887
27	Maryland.....	College Park.....	H. J. Patterson.....	1888.....	Apr. —, 1888
28	Massachusetts.....	Amherst.....	W. P. Brooks.....	1882 ¹	Mar. 2, 1888
29	Michigan.....	East Lansing.....	R. S. Shaw.....	.....	Feb. 26, 1888
30	Minnesota.....	St. Anthony Park, St. Paul.	A. F. Woods.....	Mar. 7, 1885	1888.....
31	Mississippi.....	Agricultural College.....	E. R. Lloyd.....	.....	Jan. 27, 1888
32	Missouri (College).....	Columbia.....	F. B. Mumford.....	.....	Jan. —, 1888
33	Missouri (Fruit).....	Mountain Grove.....	Paul Evans.....	Feb. 1, 1900	July 1, 1893
34	Montana.....	Bozeman.....	F. B. Linfield.....	.....

¹ In 1882 the State organized a station here and maintained it until June 18, 1895, when it was combined with the Hatch station at the same place.

1913—Continued.

Number on staff.	Number of teachers on staff.	Number of persons on staff who assist in farmers' institutes.	Publications during fiscal year 1913.		Number of names on mailing list.	Principal lines of work.	
			Number.	Pages.			
41	9	.....	25	688	24,000	Chemistry; botany; soils; field experiments; horticulture; plant breeding; forestry; diseases of plants; animal husbandry; poultry investigations; entomology; dairying; rural engineering; bacteriology; veterinary science.	19
66	40	40	11	282	15,167	Soils; inspection of feeding stuffs and fertilizer control; horticulture; plant breeding; forestry; field experiments; feeding and digestion experiments; milling and baking tests; correlation of characteristics of wheat; poultry experiments; diseases of animals; hog-cholera serum; entomology; dairying; extermination of prairie dogs and gophers; irrigation; veterinary experiments, diseases of the horse.	20
46	13	5	17	500	18,000	Chemistry; soils; bacteriology; inspection of fertilizers, foods, drugs, feeding stuffs, seeds, orchards, and nurseries; field experiments; horticulture; plant breeding; animal husbandry; diseases of plants and animals; entomology; apiculture; dairying; poultry; extension work.	21
{ 2 6 19 4 }	2	4	7	379	14,000	Rice experiments; forage crops.	22
						Chemistry; bacteriology soils; field experiments; sugar making; drainage.	23
						Botany; bacteriology; inspection of fertilizers, feeding stuffs, and Paris green; horticulture; animal husbandry; diseases of animals; entomology; field experiments.	24
						Field experiments; horticulture; feeding experiments; stock raising.	25
22	.....	.....	33	748	9,000	Chemistry; botany; analysis and inspection of foods, drugs, insecticides, fungicides, fertilizers, concentrated commercial feeding stuffs, and agricultural seeds; calibration of creamery glassware; orcharding; plant pathology; biology, investigations in animal husbandry; poultry breeding; plant breeding; entomology.	26
19	4	7	10	280	22,000	Chemistry; fertilizers; field experiments; horticulture; plant breeding; diseases of plants and animals; feeding experiments; animal breeding; poultry raising; entomology; dairying.	27
31	9	14	17	601	23,252	Chemistry; meteorology; analysis and inspection of fertilizers and concentrated commercial feeding stuffs; inspection of creamery glassware and nurseries; pot, cylinder, and field experiments; horticulture; plant breeding; diseases of plants and animals; digestion and feeding experiments; entomology; dairying; effect of electricity on plant growth.	28
29	20	.....	17	586	60,000	Chemistry; analysis and control of fertilizers; bacteriology; field experiments; horticulture; forestry; plant breeding; diseases of plants and animals; feeding and breeding experiments; poultry culture; entomology; stable hygiene.	29
65	49	.....	42	704	15,012	Fruit and vegetable breeding; insect pest investigation; orchard spraying; drainage; milling tests of cereal and flour; diseases of plants and animals; plant and animal breeding; animal nutrition; farm management; ventilation; farm statistics.	30
17	8	7	6	189	25,000	Fertilizers; field experiments; horticulture; biology; plant breeding; animal husbandry; diseases of animals; poultry culture; entomology; dairying; agricultural engineering.	31
53	43	43	17	366	11,974	Chemistry; soil survey; botany; field experiments; horticulture; diseases of plants and animals; feeding experiments; animal and plant breeding; entomology; dairying; poultry; forestry; farm management.	32
3	.....	.....	2	50	(?)	Chemistry; meteorology; botany; field experiments; dry farming; horticulture; feeding and breeding experiments; poultry experiments; veterinary science; entomology; dairying; irrigation and drainage; farm management.	33
20	9	14	14	288	11,000		34

² No data.

General statistics,

	Station.	Location.	Director.	Date of original organization.	Date of organization under Hatch Act.
35	Nebraska.....	Lincoln.....	E. A. Burnett.....	Dec. 16, 1884	June 13, 1887
36	Nevada.....	Reno.....	S. B. Doten.....		Dec. —, 1887
37	New Hampshire.....	Durham.....	J. C. Kendall.....	1886.....	Aug. 4, 1887
38	New Jersey (State)....	New Brunswick.....	J. G. Lipman.....	Mar. 10, 1880	
39	New Jersey (College)...	do.....	do.....		Apr. 26, 1888
40	New Mexico.....	State College.....	Fabian Garcia.....		Dec. 14, 1889
41	New York (State).....	Geneva.....	W. H. Jordan.....	Mar. —, 1882	
42	New York (Cornell)...	Ithaca.....	L. H. Bailey.....	1879.....	Apr. —, 1888
43	North Carolina (College).	West Raleigh.....	B. W. Kilgore.....	Mar. 12, 1877	Mar. 7, 1887
44	North Carolina (State)	Raleigh.....	do.....	1907.....	
45	North Dakota.....	Agricultural College...	J. H. Worst.....		Mar. —, 1890
46	Ohio.....	Wooster.....	C. E. Thorne.....	Apr. 25, 1882	Apr. 2, 1888
47	Oklahoma.....	Stillwater.....	J. A. Wilson.....		Dec. 25, 1890
48	Oregon.....	Corvallis.....	J. Withycombe.....		July —, 1888

1913—Continued.

Number on staff.	Number of teachers on staff.	Number of persons on staff who assist in farmers' institutes.	Publications during fiscal year 1913.		Number of names on mailing list.	Principal lines of work.	
			Number.	Pages.			
34	18	14	12	664	17,500	Chemistry; botany; meteorology; soils; field experiments; horticulture; plant breeding; diseases of plants and animals; forestry; feeding and breeding experiments; entomology; dairying; irrigation.	35
17	11	-----	2	93	5,800	Chemistry; meteorology; botany; soils; field experiments; horticulture; plant breeding; forestry; animal feeding and breeding; plant diseases; veterinary science and bacteriology; zoology; entomology; irrigation; dairying; home economics; mechanic arts.	36
19	12	10	9	132	16,000	Chemistry; botany; field experiments; horticulture; plant breeding; breeding experiments; entomology.	
17	11	11	14	298	9,000	Chemistry; oyster culture; botany; analyses of fertilizers, foods, commercial feeding stuffs, and insecticides; pot, cylinder, and field experiments; horticulture; floriculture; plant breeding; forestry; diseases of plants and animals; animal husbandry; dairy husbandry; poultry experiments; entomology; soil chemistry and bacteriology; soil surveys; irrigation; seed inspection.	38
22	6	5	8	538	8,000		39
19	19	10	5	328	5,000	Chemistry; botany; soils; field crops; dry farming; horticulture; nutrition; plant diseases; entomology; dairying; irrigation.	40
24	-----	15	36	957	47,500	Chemistry; bacteriology; meteorology; fertilizers; analysis and control of fertilizers; inspection of feeding stuffs, Paris green, and creamery glassware; field experiments; horticulture; plant breeding; diseases of plants; feeding experiments; poultry experiments; entomology; dairying; soil studies.	41
45	37	6	26	987	34,987	Chemistry; soils; field experiments; farm crops; farm management; horticulture; forestry; plant breeding; plant physiology; diseases of plants; feeding and breeding experiments; poultry husbandry; entomology; dairying; rural economy; rural engineering.	42
17	6	3	1	149	18,000	Chemistry; soils; field experiments; horticulture; nitrification experiments; diseases of plants and animals; animal husbandry; poultry experiments; dairying; tests of farm machinery; cottonseed feeding; toxic investigations; entomology investigations; plant breeding investigations; horticulture and agronomic experiments.	43
31	-----	-----	15	(¹)	37,500	Chemistry; soils; field experiments; horticulture; diseases of animals; feeding experiments; entomology; fertilizer experiments and analyses; inspection of foods and stock feeds; cooperative demonstration work with farmers; farmers' institutes.	44
45	24	8	8	313	14,000	Chemistry; soils; botany; field experiments; plant breeding; horticulture; forestry; diseases of plants and animals; analysis of foods and spraying materials; seed inspection; inspection and analysis of paints, drugs, proprietary products, and feeding stuffs; feeding and breeding experiments; poultry experiments; milling and chemical tests of wheat; drainage; farm engineering; farm management.	45
66	-----	28	25	764	65,000	Chemistry; soils; field experiments; botany; horticulture; plant breeding; forestry; diseases of plants; feeding experiments; entomology; nutrition; farm management; dairying; climatology.	46
17	11	7	7	227	15,000	Chemistry; agronomy; field experiments; horticulture; forestry; botany; bacteriology; animal husbandry; dairying; veterinary science; entomology.	47
42	17	13	3	73	20,000	Chemistry; bacteriology; soils; fertilizers; field crops; horticulture; plant breeding and selection; diseases of plants; feeding experiments; poultry experiments; entomology; dairying; irrigation.	48

¹ No data.

General statistics,

	Station.	Location.	Director.	Date of original organization.	Date of organization under Hatch Act.
49	Pennsylvania.....	State College.....	R. L. Watts.....		June 30, 1887
50	Pennsylvania (Nutri- tion).....	.....do.....	H. P. Armsby.....	1907.....	
51	Porto Rico.....	Mayaguez.....	D. W. May.....	Nov. —, 1901	
52	Rhode Island.....	Kingston.....	Burt L. Hartwell..		July 30, 1888
53	South Carolina.....	Clemson College.....	J. N. Harper.....		Jan. —, 1888
54	South Dakota.....	Brookings.....	J. W. Wilson.....		Mar. 13, 1887
55	Tennessee.....	Knoxville.....	H. A. Morgan.....	June 8, 1882	Aug. 4, 1887
56	Texas.....	College Station.....	B. Youngblood.....		Apr. 3, 1889
57	Utah.....	Logan.....	E. D. Ball.....		1890.....
58	Vermont.....	Burlington.....	J. L. Hills.....	Nov. 24, 1886	Feb. 28, 1888
59	Virginia.....	Blacksburg.....	S. W. Fletcher.....	1888.....	1891.....
60	.....do.....	Norfolk.....	T. C. Johnson.....		
61	Washington.....	Pullman.....	I. D. Cardiff.....		1891.....
62	West Virginia.....	Morgantown.....	E. D. Sanderson.....		June 11, 1888
63	Wisconsin.....	Madison.....	H. L. Russell.....	1883.....	1887.....
64	Wyoming.....	Laramie.....	H. G. Knight.....		Mar. 1, 1891
	Total.....	.....	.....	.....	.....

1913—Continued.

Number on staff.	Number of teachers on staff.	Number of persons on staff who assist in farmers' institutes.	Publications during fiscal year 1913		Number of names on mailing list.	Principal lines of work.	
			Number	Pages.			
49	35	16	5	108	43,800	Chemistry; meteorology; fertilizers; horticulture; forestry; plant diseases; field experiments; feeding experiments; dairying; poultry experiments. Scientific investigations of animal nutrition.....	49
7	1	-----	-----	-----	(1)		50
9	-----	-----	4	116	(1)	Chemistry; soils; fertilizers; horticulture; plant diseases; entomology; animal breeding; dairying; tropical field and orchard crops.	51
15	2	4	5	277	10,180	Chemistry; meteorology; soils; analysis and inspection of fertilizers and feeding stuffs; field and pot experiments; horticulture; poultry diseases, poultry feeding, and pigeon and poultry breeding.	52
22	11	10	11	232	19,000	Chemistry; soils; botany; field experiments; horticulture; plant breeding; diseases of plants; feeding and breeding experiments; veterinary science; entomology; dairying.	53
18	12	6	8	300	22,000	Chemistry; horticulture; field experiments; plant breeding; diseases of plants and animals; animal husbandry; dairying.	54
22	7	10	5	136	13,600	Chemistry; soil investigations; field experiments; horticulture; plant breeding; seeds; weeds; diseases of plants and animals; feeding experiments; entomology; dairying; apiculture.	55
30	5	-----	10	289	30,000	Chemistry; examination and comparison of commercial feeding stuffs and fertilizers; soils; field experiments; horticulture; plant breeding; feeding experiments; diseases of plants and animals and selection; entomology; cotton investigations; breeding experiments.	56
26	12	-----	8	184	12,500	Chemistry of soils; field experiments; horticulture; diseases of plants; breeding and feeding experiments; poultry breeding; incubation; entomology; irrigation and drainage; arid farming.	57
18	5	-----	7	-----	15,000	Chemistry; botany; bacteriology; analysis and control of fertilizers and feeding stuffs; inspection of creamery glassware; horticulture; diseases of plants; feeding and breeding experiments; dairying.	58
22	8	7	4	312	14,500	Chemistry; field experiments; pomology; plant breeding; soil bacteriology; mycology; feeding experiments; dairying.	59
5	-----	2	-----	-----	7,000	Field experiments; plant breeding; plant diseases; entomology.	60
18	16	11	12	279	19,500	Chemistry; plant physiology; bacteriology; soils; field experiments; horticulture; plant breeding; diseases of plants; feeding and breeding experiments; veterinary science; entomology; irrigation; dry farming; clearing logged-off lands.	61
25	13	10	7	286	7,200	Chemistry; effect of pressure on bacteria; artificial fixation of atmospheric nitrogen; analysis and control of fertilizers; soils; farm crops; horticulture; diseases of plants and animals; feeding experiments; poultry experiments; entomology; dairying; veterinary science.	62
84	73	4	24	1,064	29,433	Chemistry; bacteriology; soils; field experiments; agronomy; tobacco and cranberry culture; horticulture; plant breeding; plant pathology; breeding and feeding experiments; poultry experiments; veterinary science; entomology; dairying; irrigation and drainage; agricultural engineering; agricultural economics; forestry; home economics; extension.	63
13	-----	-----	-----	-----	(1)	Chemistry; mycology; botany; meteorology; soils; range improvements; fertilizers; field experiments; plant selection; poisonous-plant investigations; breeding and feeding experiments; wool investigation; veterinary science; irrigation; parasitology; effects of alkali on structural and other material.	64
1,667	779	522	641	20,040	1,010,668		

¹ No data.

Revenue and additions to

	Station.	Federal.		State.	Indi- viduals and com- munities.	Fees.	Farm products.	Miscella- neous. ¹
		Hatch fund.	Adams fund.					
1	Alabama (College).	\$15,000.00	\$15,000.00	\$27,253.35	-----	-----	\$848.10	\$6,486.02
2	Alabama (Cane- brake) ² .	-----	-----	-----	-----	-----	-----	-----
3	Alabama (Tuske- gee).	-----	-----	(?)	-----	-----	-----	-----
4	Arizona.	15,000.00	15,000.00	18,000.00	\$2,336.10	-----	3,884.06	3,770.07
5	Arkansas.	15,000.00	15,000.00	3,000.00	-----	-----	-----	-----
6	California.	15,000.00	15,000.00	192,721.54	-----	\$41,815.68	110,598.33	93,685.28
7	Colorado.	15,000.00	15,000.00	11,250.00	-----	-----	-----	293.83
8	Connecticut (State)	7,500.00	7,500.00	20,000.00	11,317.88	9,744.55	27.85	793.37
9	Connecticut (Storrs)	7,500.00	7,500.00	4,500.00	-----	-----	-----	2,163.49
10	Delaware.	15,000.00	15,000.00	-----	-----	-----	6,796.87	-----
11	Florida.	15,000.00	15,000.00	-----	-----	-----	-----	1,830.55
12	Georgia.	15,000.00	15,000.00	1,080.12	90.08	-----	3,673.30	11,594.69
13	Idaho.	15,000.00	15,000.00	-----	-----	-----	9,769.22	3,736.67
14	Illinois.	15,000.00	15,000.00	168,000.00	-----	-----	31,842.60	41,993.99
15	Indiana.	15,000.00	15,000.00	75,000.00	-----	-----	-----	105,163.58
16	Iowa.	15,000.00	15,000.00	55,000.00	-----	-----	16,043.92	23,061.64
17	Kansas.	15,000.00	15,000.00	22,500.00	-----	-----	-----	-----
18	Kentucky.	15,000.00	15,000.00	157,636.30	-----	59,636.65	9,522.73	22,293.34
19	Louisiana.	15,000.00	15,000.00	22,208.30	-----	24,000.00	5,114.22	11,801.31
20	Maine.	15,000.00	15,000.00	15,000.00	-----	-----	-----	11,410.95
21	Maryland.	15,000.00	15,000.00	10,000.00	-----	-----	10,255.20	224.88
22	Massachusetts.	15,000.00	15,000.00	19,875.00	-----	10,444.99	4,361.77	16,144.68
23	Michigan.	15,000.00	15,000.00	20,451.85	-----	5,720.00	-----	362.80
24	Minnesota.	15,000.00	15,000.00	247,817.81	-----	-----	29,483.38	-----
25	Mississippi.	15,000.00	15,000.00	-----	-----	180.00	11,049.02	9,354.10
26	Missouri (College).	15,000.00	15,000.00	11,251.82	-----	-----	6,874.71	123,633.79
27	Missouri (Fruit) ² .	-----	-----	-----	-----	-----	-----	-----
28	Montana.	15,000.00	15,000.00	22,581.35	-----	-----	7,000.00	-----
29	Nebraska.	15,000.00	15,000.00	-----	-----	-----	-----	53,739.39
30	Nevada.	15,000.00	15,000.00	5,000.00	-----	-----	189.70	2,525.59
31	New Hampshire.	15,000.00	15,000.00	-----	-----	-----	1,881.37	6,436.96
32	New Jersey (State)	-----	-----	-----	-----	-----	-----	-----
33	New Jersey (Col- lege).	15,000.00	15,000.00	95,883.31	-----	-----	-----	-----
34	New Mexico.	15,000.00	15,000.00	-----	-----	55.00	2,015.23	1,754.16
35	New York (State).	1,500.00	1,500.00	124,330.20	-----	-----	-----	10,088.97
36	New York (Cornell)	13,500.00	13,500.00	-----	-----	-----	-----	-----
37	North Carolina (College).	15,000.00	15,000.00	-----	-----	-----	5,103.81	3,981.29
38	North Carolina (State).	-----	-----	-----	-----	-----	-----	-----
39	North Dakota.	15,000.00	15,000.00	13,242.33	-----	-----	-----	20,518.52
40	Ohio.	15,000.00	15,000.00	229,200.00	-----	-----	12,271.21	189,912.64
41	Oklahoma.	15,000.00	15,000.00	-----	-----	-----	-----	2,440.64
42	Oregon.	15,000.00	15,000.00	49,500.00	6,276.66	-----	9,557.71	38,303.11
43	Pennsylvania.	15,000.00	15,000.00	6,000.00	-----	14,416.00	16,477.65	5,107.79
44	Pennsylvania (Nu- trition).	-----	-----	-----	-----	-----	-----	-----
45	Rhode Island.	15,000.00	15,000.00	-----	-----	-----	-----	5,974.79
46	South Carolina.	15,000.00	15,000.00	-----	-----	-----	1,681.02	2,064.82
47	South Dakota.	15,000.00	15,000.00	10,000.00	-----	-----	3,298.77	4,538.28
48	Tennessee.	15,000.00	15,000.00	19,000.00	-----	-----	6,138.65	-----
49	Texas.	15,000.00	15,000.00	53,000.00	1,007.00	-----	730.81	1,669.01
50	Utah.	15,000.00	15,000.00	16,791.54	-----	-----	2,501.54	1,007.06
51	Vermont.	15,000.00	15,000.00	380.52	160.16	2,555.61	-----	-----
52	Virginia (College).	15,000.00	15,000.00	13,000.00	-----	-----	3,224.46	3,072.58
53	Virginia (Truck).	-----	-----	12,500.00	-----	-----	-----	-----
54	Washington.	15,000.00	15,000.00	19,061.17	-----	756.00	4,816.12	587.73
55	West Virginia.	15,000.00	15,000.00	-----	-----	14,531.64	8,322.51	-----
56	Wisconsin.	15,000.00	15,000.00	15,000.00	-----	11,500.00	-----	-----
57	Wyoming.	15,000.00	15,000.00	-----	-----	-----	2,073.16	7.32
	Total.	720,000.00	720,000.00	1,807,016.51	21,187.88	195,356.12	347,429.00	843,529.26

¹ Includes all balances.² No report received.³ Amount of appropriation not reported.

equipment, 1913.

Total.	Additions to equipment.						Total.	
	Buildings.	Library.	Apparatus.	Farm im- plements.	Live stock.	Miscella- neous.		
\$64,587.47	\$241.00	.....	\$221.00	\$301.00	\$200.00	\$225.00	\$1,188.00	1
.....	.....	.....	.....	.....	.....	.....	.....	2
.....	.....	.....	.....	.....	.....	.....	.....	3
57,990.23	1,871.96	\$49.30	686.14	1,146.38	412.50	1,039.95	5,206.23	4
33,000.00	.....	200.00	1,500.00	100.00	1,500.00	500.00	3,800.00	5
468,820.83	15,261.78	898.24	2,461.75	1,424.52	5,285.25	574.31	25,905.85	6
41,543.83	2,921.50	291.34	1,349.96	732.44	38.00	506.00	5,839.24	7
56,883.65	.....	1,136.63	334.90	117.60	.....	1,338.75	2,927.88	8
21,663.49	918.28	137.67	48.60	84.42	.....	.....	1,188.97	9
36,796.87	2,021.53	201.80	482.41	296.60	1,260.19	382.35	4,644.88	10
31,830.55	786.21	414.48	687.45	417.03	.....	56.30	2,361.47	11
46,438.19	7,400.00	50.00	200.00	250.00	.....	400.00	8,300.00	12
43,505.89	312.25	205.65	1,308.07	1,318.41	4,681.00	1,579.45	9,404.83	13
271,836.59	17,669.74	125.98	714.05	4,941.12	5,781.67	1,609.95	30,842.51	14
210,163.58	26,535.53	732.81	612.24	1,588.84	30,262.55	3,166.29	62,898.26	15
124,105.56	.....	.....	2,018.90	248.22	1,700.00	.....	3,967.12	16
52,500.00	.....	.....	.....	.....	.....	.....	.....	17
279,089.02	70,000.00	1,100.00	900.00	1,500.00	750.00	1,200.00	75,450.00	18
93,123.83	8,566.43	136.53	579.08	2,528.53	611.25	.....	12,421.82	19
56,410.95	4,156.97	900.96	638.88	480.61	.....	.....	6,177.42	20
50,480.08	3,762.05	704.73	1,341.47	495.26	537.00	1,449.02	8,289.53	21
80,826.44	.....	292.88	675.16	74.27	222.00	.....	1,264.31	22
56,534.65	3,027.00	1,136.07	2,110.89	496.53	2,442.47	328.89	9,541.85	23
307,301.19	.....	1,825.66	8,962.89	9,672.34	10,877.50	19,983.02	51,321.41	24
50,583.12	7,350.00	120.57	714.10	1,720.90	1,199.86	815.96	19,850.49	25
171,759.90	37,720.26	.....	4,430.16	1,585.67	6,488.69	.....	50,224.78	26
.....	.....	.....	.....	.....	.....	.....	.....	27
59,581.35	500.00	310.00	465.00	1,200.00	2,200.00	.....	4,675.00	28
83,739.39	107,500.00	.....	297.22	287.40	6,921.00	.....	115,005.62	29
37,715.29	.....	11.25	1,075.95	107.80	134.00	.....	1,329.00	30
38,318.33	458.12	450.60	890.15	181.89	1,199.37	516.88	3,697.01	31
.....	5,285.25	85.94	1,042.13	2,149.98	1,455.00	742.65	10,760.95	32
.....	.....	.....	.....	.....	.....	.....	.....	33
125,883.31	1,160.58	1,053.58	133.67	174.09	.....	126.66	2,648.58	34
33,824.39	1,564.80	99.54	504.99	1,626.93	505.50	420.11	4,721.87	35
137,419.17	2,750.00	1,255.92	1,644.57	1,164.56	735.00	.....	7,550.05	36
27,000.00	4,227.64	575.52	10,862.97	1,046.45	230.00	884.75	17,827.33	37
.....	.....	.....	.....	.....	.....	.....	.....	38
39,085.10	1,000.00	434.15	232.21	400.00	200.00	.....	2,266.36	39
.....	.....	.....	.....	.....	.....	.....	.....	40
.....	2,500.00	500.00	.....	500.00	2,500.00	.....	6,000.00	41
63,760.85	.....	2,071.31	2,906.79	2,614.02	2,550.75	4,695.07	14,837.94	42
461,383.85	15,279.63	2,058.29	2,005.29	6,836.79	4,181.31	.....	30,361.31	43
32,440.64	847.20	231.47	297.94	547.44	866.55	500.07	3,290.67	44
133,637.48	4,304.49	188.09	1,423.69	1,336.83	491.07	243.63	7,987.80	45
72,001.44	.....	222.38	791.25	602.11	3,250.20	.....	4,865.94	46
.....	.....	.....	.....	.....	.....	.....	.....	47
.....	.....	444.50	1,495.95	.....	.....	.....	1,940.45	48
35,974.79	14.20	677.20	135.99	172.42	330.50	928.25	2,258.56	49
33,745.84	2,640.05	296.79	307.16	1,227.72	1,902.26	49.40	6,423.38	50
47,837.05	1,000.00	8.50	625.00	1,500.00	1,420.00	.....	4,553.50	51
55,138.65	4,100.00	333.72	1,131.86	1,756.68	395.00	610.66	8,327.92	52
86,406.82	9,525.57	157.93	671.12	6,520.85	1,969.04	94.70	18,939.21	53
50,300.14	1,002.92	178.75	577.29	2,191.19	363.75	338.62	4,652.52	54
33,096.29	1,206.90	106.80	104.36	126.15	.....	.....	1,544.21	55
49,297.04	317.43	506.39	628.26	906.29	1,327.00	109.40	3,794.77	56
12,500.00	.....	39.77	.....	213.69	500.00	.....	753.46	57
55,221.02	1,429.54	341.90	960.63	416.67	931.04	3,981.23	8,061.01	58
52,854.15	.....	198.74	644.22	405.26	75.00	200.00	1,523.22	59
56,500.00	16,000.00	1,540.00	2,316.00	1,831.00	4,325.00	1,803.00	27,815.00	60
32,080.48	.....	.....	.....	.....	.....	.....	.....	61
4,654,518.77	395,136.81	25,040.33	67,149.76	69,564.00	123,138.27	51,400.32	731,429.49	62

Expenditures from United States appropriation received under the act of Mar. 2, 1887 (Hatch Act) for the year ended June 30, 1913.

Station.	Amount of appropriation.	Classified expenditures.							
		Salaries.	Labor.	Publications.	Postage and stationery.	Freight and express.	Heat, light, and water.	Chemical supplies.	Seeds, plants, and sundry supplies.
Alabama.....	\$15,000.00	\$8,092.94	\$1,337.26	\$1,279.45	\$427.15	\$135.33	\$892.61	\$599.25	\$390.46
Arizona.....	13,000.00	7,210.63	1,173.91	241.28	1,021.30	316.91	137.01	17.06	832.90
Arkansas.....	13,000.00	8,234.67	2,428.63	773.43	636.88	152.36	326.99	25.65	385.50
California.....	13,000.00	7,249.59	4,784.16	1,999.08	954.51	151.78	94.63	360.09	76.46
Colorado.....	13,000.00	9,341.13	1,311.43	1,355.11	511.08	134.75		7.25	119.73
Connecticut (State).....	7,500.00	6,750.15	377.00	272.79					
Connecticut (Stores).....	7,500.00	6,173.06	364.90		25.66	32.66	24.28	174.96	427.25
Delaware.....	13,000.00	5,939.14	3,151.88	1,211.15	348.32	295.52	389.65	5.00	642.05
Florida.....	13,000.00	6,463.34	2,967.46	1,540.46	636.21	160.98	261.93	2.00	282.62
Georgia.....	13,000.00	6,890.04	3,334.73	949.50	250.83	95.91	220.17	9.70	275.07
Idaho.....	13,000.00	8,507.00	1,569.82	1,153.60	217.02	186.68	513.21	130.10	163.54
Illinois.....	13,000.00	7,982.92	2,227.25	1,570.88	843.05	43.07	115.50	72.74	132.94
Indiana.....	13,000.00	10,252.00	1,434.57	945.20	130.31	33.91	617.76	16.46	345.11
Iowa.....	13,000.00	7,441.57	1,534.81	2,017.63	221.73	132.48	17.76	63.64	1,978.74
Kansas.....	13,000.00	6,286.71	5,734.81	96.44	138.93	122.06	77.76	549.28	345.13
Kentucky.....	13,000.00	8,280.35	1,874.55	235.43	822.10	101.94	366.96	130.73	284.52
Louisiana.....	13,000.00	8,280.35	1,874.55	235.43	822.10	101.94	366.96	130.73	284.52
Maine.....	13,000.00	13,245.68	3,683.41	1,739.32	407.65	317.82	271.81	158.33	736.14
Maryland.....	13,000.00	13,245.68	3,683.41	1,739.32	407.65	317.82	271.81	158.33	736.14
Massachusetts.....	13,000.00	9,689.91	2,319.19	286.23	108.15	6.25	20.76	268.82	369.52
Michigan.....	13,000.00	8,554.55	2,892.09	286.04	341.26	61.75	115.32	513.59	467.21
Minnesota.....	13,000.00	9,039.78	3,341.80	913.55	122.55	64.75		392.05	113.89
Mississippi.....	13,000.00	9,623.17	3,320.71	957.64	315.57	332.34	105.04	1.85	791.77
Missouri.....	13,000.00	9,434.49	1,372.88	8.41	489.86	332.34	2.00	327.15	110.71
Montana.....	13,000.00	11,783.33	1,426.82	361.59	449.39	107.35	40.32	109.46	188.83
Nebraska.....	13,000.00	7,074.53	3,011.14	1,953.69	561.48	8.96		28.79	284.16
Nevada.....	13,000.00	8,809.27	2,392.20	20.00	396.64	196.11	117.05	304.89	386.99
New Hampshire.....	13,000.00	8,199.06	1,723.35	1,231.89	566.16	240.52	659.67	41.05	332.12
New Jersey.....	13,000.00	9,434.90	1,422.80	45.90	526.74	28.50	843.67	54.94	312.71
New Mexico.....	13,000.00	7,252.17	3,430.21	408.99	267.12	254.10	233.92	96.92	288.88
New York (State).....	1,500.00	1,500.00							
New York (Cornell).....	13,500.00	6,218.27	3,951.57	131.85	911.43	175.13	369.44	214.32	311.72
North Carolina.....	15,000.00	7,187.45	2,782.60		603.07	262.05	122.54	21.93	726.91
North Dakota.....	15,000.00	11,042.94	3,193.48		24.00				56.25
Ohio.....	15,000.00	14,296.72	683.28						
Oklahoma.....	15,000.00	9,352.88	1,767.51	1,750.35	484.55	57.52	218.53	93.90	242.00
Oregon.....	15,000.00	9,212.03	3,019.82	43.20	96.30	20.53	37.65	187.99	582.61
Pennsylvania.....	15,000.00	8,326.66	2,434.05	1,233.21	222.35	178.77	27.27	117.44	115.88

Rhode Island.....	15,000.00	7,273.48	2,465.84	1,041.49	260.43	80.13	262.89	359.19	207.25
South Carolina.....	15,000.00	8,315.91	3,062.06	1,762.82	80.55	74.49	121.94	77.89	341.47
South Dakota.....	15,000.00	8,293.82	2,028.00	2,112.11	61.05	84.67	3.80	113.91	237.58
Tennessee.....	15,000.00	8,940.00	2,556.29	474.39	230.89	111.90	501.31	171.28	347.19
Texas.....	15,000.00	8,904.87	2,108.45	.....	608.97	220.13	37.10	45.81	179.16
Utah.....	15,000.00	8,976.10	2,501.52	184.50	565.44	220.07	169.54	136.37	142.80
Vermont.....	15,000.00	8,172.26	2,225.89	108.31	462.00	28.60	867.10	365.00	383.05
Virginia.....	15,000.00	7,866.96	2,191.57	1,766.65	592.76	136.69	.....	33.66	403.38
Washington.....	15,000.00	8,583.27	2,898.74	655.55	565.27	174.36	28.70	179.55	221.19
West Virginia.....	15,000.00	10,735.00	1,122.03	.....	200.44	.....	68.32	93.62	164.88
Wisconsin.....	15,000.00	9,400.00	3,300.00	.....	66.83	.....	.....	156.80	125.13
Wyoming.....	15,000.00	6,673.00	2,885.21	748.42	380.82	224.47	492.86	145.27	302.07
Total.....	720,000.00	412,440.36	115,931.40	32,959.41	18,459.91	5,591.58	9,677.82	7,122.69	16,872.09

South Carolina.....	529.05	838.02	198.08	307.07	172.73	23.80	26.00	39.12	20.00	702.71	.....
South Dakota.....	335.80	335.80	3.50	.....	479.45	114.50	345.23	107.87	.....	.....	.....
Tennessee.....	827.07	827.07	186.61	314.31	87.35	83.50	.....	52.95	20.00	25.46	.....
Texas.....	806.65	806.65	51.24	894.11	365.22	58.27	.....	365.49	20.00	153.13	.....
Utah.....	515.54	515.54	136.81	287.34	162.30	162.30	212.50	377.76	20.00	465.11	.....
Vermont.....	971.38	971.38	104.08	31.62	73.60	85.00	.....	519.15	20.00	462.51	.....
Virginia.....	123.45	123.45	506.39	315.94	74.65	85.05	480.50	290.78	40.00	134.22	.....
Washington.....	17.85	143.05	333.82	181.60	123.60	320.86	5.00	461.15	.....	75.74	.....
West Virginia.....	11.05	180.45	192.40	402.26	200.00	9.78	75.00	585.41	.....	12.00	.....
Wisconsin.....	104.46	1,024.40	243.14	111.31	34.22	299.51	9.50	38.35	.....	6.75	.....
Wyoming.....	16.98	1,201.46	135.54	138.40	234.40	176.56	187.50	324.54	20.00	121.16	.....
Wyoming.....	86.30	1,718.48	.....	.....	.....	.....	.....	.....	.....	.....	.....
Total.....	5,547.69	33,147.91	9,042.72	11,486.76	7,608.19	4,881.16	8,066.33	9,813.00	1,057.76	9,055.37	1,228.85

Expenditures from United States appropriation received under the act of Mar. 16, 1906 (Adams Act), for the year ended June 30, 1913.

Station.	Amount of appropriation.	Classified expenditures—Continued.					
		Salaries.	Labor.	Postage and stationery.	Freight and express.	Heat, light, and water.	Chemical supplies.
Alabama.....	\$15,000.00	\$10,133.80	\$1,840.39	\$74.19	\$68.27	\$296.34	\$633.57
Arizona.....	15,000.00	10,814.71	2,445.13	57.84	127.35	52.70	57.72
Arkansas.....	15,000.00	9,936.40	1,573.43	116.36	157.42	133.99	389.65
California.....	15,000.00	6,914.38	2,010.59	32.42	178.62	103.80	1,198.61
Colorado.....	15,000.00	11,655.65	137.87	84.77	149.08	.....	845.39
Connecticut (State).....	7,500.00	4,524.42	616.07	.....	97.24	480.58	403.07
Connecticut (Stores).....	15,000.00	3,595.52	730.40	6.15	6.30	32.50	170.47
Delaware.....	15,000.00	10,751.80	798.43	25.04	74.89	211.11	878.28
Florida.....	15,000.00	13,091.20	941.98	139.01	139.01	16.00	545.25
Georgia.....	15,000.00	11,638.46	1,515.35	167.19	57.06	181.14	135.10
Idaho.....	15,000.00	11,638.70	1,515.77	165.37	273.44	90.98	135.15
Illinois.....	15,000.00	11,743.19	2,132.24	7.35	47.37	.....	91.97
Indiana.....	15,000.00	10,716.47	1,033.14	35.36	14.94	.....	216.02
Iowa.....	15,000.00	8,624.41	1,255.92	80.62	14.27	67.02	1,228.54
Kansas.....	15,000.00	7,559.87	3,633.84	49.13	15.88	119.47	626.62
Kentucky.....	15,000.00	13,479.60	1,001.54	40.60	5.80	22.07	242.22
Louisiana.....	15,000.00	12,876.20	423.01	43.15	63.43	287.83	136.06
Maine.....	15,000.00	11,551.27	130.71	48.75	153.72	181.04	42.26
Maryland.....	15,000.00	11,520.32	694.32	.....	.....	160.22	212.08
Massachusetts.....	15,000.00	12,533.58	931.46	21.16	14.31	110.94	514.26
Michigan.....	15,000.00	10,869.06	1,462.52	15.23	3.87	726.38	148.21
Minnesota.....	15,000.00	13,570.00	411.88	63.01	18.13	.....	185.91
Mississippi.....	15,000.00	8,318.78	3,747.24	52.86	127.27	21.02	325.03
Missouri.....	15,000.00	5,973.22	3,201.59	10.32	.....	9.50	1,905.95
Montana.....	15,000.00	11,658.33	1,562.50	34.66	191.79	1.20	236.47
Nebraska.....	15,000.00	10,369.73	2,747.38	.....	95.58	.....	136.75
Nevada.....	15,000.00	11,308.10	313.45	29.53	71.02	124.50	191.77
New Hampshire.....	15,000.00	8,386.23	2,827.64	8.74	345.85	.....	135.93
New Jersey.....	15,000.00	11,625.00	985.40	52.08	9.05	287.68	192.96
New Mexico.....	15,000.00	7,580.51	2,650.68	46.88	168.77	273.70	185.16
New York (State).....	1,500.00	1,471.20	.....	.....	.....	.....	393.31
New York (Cornell).....	13,500.00	6,753.23	4,817.34	134.75	14.32	.....	541.96
North Carolina.....	15,000.00	11,340.17	1,683.48	246.79	52.80	194.44	426.66
North Dakota.....	15,000.00	9,754.04	1,326.03	5.50	30.30	8.25	772.15
Ohio.....	15,000.00	12,401.72	790.25	.....	13.79	.....	1,322.23
Oklahoma.....	15,000.00	8,437.40	2,458.85	28.05	130.21	176.45	111.71
Oregon.....	15,000.00	11,618.35	791.34	1.80	77.21	104.87	762.22
Pennsylvania.....	15,000.00	10,055.01	1,002.58	17.98	154.10	125.75	806.25
Rhode Island.....	15,000.00	8,539.72	2,922.22	87.69	80.09	610.70	271.73
							245.08
							296.80
							282.53
							114.26
							330.77
							227.18
							360.91
							480.17

South Carolina.....	15,000.00	8,186.69	3,421.18	89.39	51.49	57.40	229.27	511.69
South Dakota.....	15,000.00	9,479.99	2,549.92	85.59	476.83	163.26	227.79	409.11
Tennessee.....	15,000.00	11,113.33	736.45	5.01	125.62	78.47	432.89	285.72
Texas.....	15,000.00	10,643.61	1,435.23	40.19	155.04	82.50	384.82	262.13
Utah.....	15,000.00	8,457.41	4,421.72	30.25	13.08	156.35	431.11	192.37
Vermont.....	15,000.00	8,380.70	3,463.62	62.12	31.48	.....	226.00	103.34
Virginia.....	15,000.00	9,414.56	1,743.56	41.43	117.27	70.00	405.98	316.76
Washington.....	15,000.00	9,456.56	2,786.45	5.00	30.21	56.41	734.12	172.14
West Virginia.....	15,000.00	10,673.34	1,245.36	6.32	.....	49.30	312.12	230.17
Wisconsin.....	15,000.00	7,800.00	2,442.00	2.50	10.00	3.75	530.83	1,106.43
Wyoming.....	15,000.00	10,988.00	462.10	6.50	126.46	71.25	562.42	51.77
Total.....	720,000.00	486,081.29	83,618.77	2,434.96	4,481.94	5,204.68	23,145.87	15,860.26

Expenditures from United States appropriation received under the act of Mar. 16, 1906 (Adams Act), for the year ended June 30, 1913—Continued.

Classified expenditures—Continued.

Station.	Fertilizers.	Feeding stuffs.	Library.	Tools, implements, and machinery.	Furniture and fixtures.	Scientific apparatus.	Live stock.	Traveling expenses.	Contingent expenses.	Buildings and repairs.	Balances.
Alabama.....	\$220.44	\$382.05	.....	\$53.08	\$125.75	\$168.37	\$220.76	\$354.87	.....	\$172.00	.....
Arizona.....	229.92	139.31	.....	165.41	21.00	145.11	.....	802.48	\$6.25	60.39	.....
Arkansas.....	.....	35.75	.....	105.95	60.33	826.56	20.00	789.14	.....	71.65	\$100.00
California.....	3.75	150.54	\$87.44	294.15	86.95	1,092.63	685.00	1,692.33	23.00	147.91	.....
Colorado.....	.....	19.48	50.43	114.70	64.45	1,028.95	.....	654.85	.....	742.92	.....
Connecticut (State).....	95.30	156.88	.....	2.25	36.51	.....	.....	230.46	.....	37.50	.....
Connecticut (Storrs).....	.....	256.50	.....	37.00	.....	6.00	15.50	67.93	.....	82.45	.....
Delaware.....	186.17	.....	26.84	257.87	.....	452.31	797.56	435.26	.....	149.97	.....
Florida.....	7.63	.....	42.72	111.49	.....	305.86	.....	599.65	.....	169.26	.....
Georgia.....	68.29	604.26	64.47	164.49	65.45	155.18	72.75	29.80	.....	169.26	.....
Idaho.....	12.25	14.50	21.47	63.45	176.00	913.91	.....	605.57	.....	22.45	3,359.83
Illinois.....	.....	384.69	.....	32.30	.....	85.72	458.37	9.09	.....	.....	.....
Indiana.....	.....	265.23	159.50	.....	.....	55.60	1,553.40	419.78	6.32	.....	.....
Iowa.....	1.15	1,904.53	.....	33.40	.....	747.00	.....	260.69	.....	.....	.....
Kansas.....	.....	1,181.88	41.00	132.10	1.05	225.79	72.95	249.01	3.00	337.55	.....
Kentucky.....	.....	62.55	149.96	.....	12.25	105.10	286.00	224.29	142.00	12.50	.....
Louisiana.....	.....	258.56	103.98	36.98	44.48	426.87	.....	164.17	.....	22.08	.....
Maine.....	.....	817.43	82.27	187.39	.....	512.84	97.00	463.16	.....	278.65	.....
Maryland.....	7.00	1,061.20	320.53	.....	176.25	408.73	.....	21.66	.....	141.66	.....
Massachusetts.....	88.05	.....	22.03	5.29	.....	.....	.....	119.80	.....	302.80	.....
Michigan.....	.....	38.00	38.43	17.95	9.00	1,383.08	33.00	76.61	.....	108.16	.....
Minnesota.....	.....	56.99	.....	136.17	96.45	53.00	.....	243.86	.....	25.66	.....
Mississippi.....	4.50	1,332.86	147.22	126.75	34.32	299.23	.....	17.92	.25	253.33	.....
Missouri.....	72.20	2,163.86	.....	34.00	7.00	523.11	46.00	236.77	.....	24.20	.....
Montana.....	.....	61.00	36.93	25.99	48.40	190.34	300.00	441.85	.....	73.79	.....
Nebraska.....	.....	.....	14.63	162.48	.....	283.53	.....	571.81	.....	.....	.....
Nevada.....	.....	252.10	10.71	32.00	70.00	261.10	3.50	646.94	15.00	51.05	1,483.30
New Hampshire.....	163.51	782.41	.....	213.61	90.82	566.70	.....	736.00	.....	736.00	.....
New Jersey.....	7.00	300.00	139.30	106.79	67.31	96.89	3.90	319.45	.....	683.63	.....
New Mexico.....	18.90	439.67	.....	1,213.75	342.00	356.37	305.50	50.20	.....	736.79	.....
New York (State).....	.....	.....	76.56	110.21	330.67	28.50	.....	72.91	.....	373.97	.....
New York (Cornell).....	29.00	316.67	.....	.....	.....	156.01	92.25	97.11	.....	97.82	.....
North Carolina.....	25.90	528.80	31.21	374.33	8.40	1,177.06	616.50	40.90	.....	17.50	.....
Ohio.....	.....	13.00	109.34	77.50	.....	5.50	110.11	140.11	.....	.....	.....
Oklahoma.....	.....	1,111.65	140.57	260.34	216.50	239.29	556.55	40.71	5.00	749.75	.....
Oregon.....	.....	80.65	.....	22.85	58.30	500.31	3.40	541.43	.....	36.64	.....
Pennsylvania.....	1,006.97	.....	.....	326.97	.....	109.86	90.50	16.99	.....	74.55	.....
Rhode Island.....	.....	1,141.07	13.00	536.96	24.25	.....	.....	.....	.....	.....	.....

Disbursements from the United States Treasury to the States and Territories for agricultural experiment stations under the acts of Congress approved Mar. 2, 1887, and Mar. 16, 1906.

State or Territory.	Hatch Act.		Adams Act.	
	1888-1912	1913	1906-1912	1913
Alabama.....	\$374,199.34	\$15,000.00	\$71,619.89	\$15,000.00
Arizona.....	339,803.15	15,000.00	75,000.00	15,000.00
Arkansas.....	373,151.12	14,988.00	75,000.00	15,000.00
California.....	375,000.00	15,000.00	74,926.84	15,000.00
Colorado.....	374,718.82	15,000.00	73,638.93	15,000.00
Connecticut.....	375,000.00	15,000.00	75,000.00	15,000.00
Dakota Territory.....	56,250.00			
Delaware.....	374,382.87	15,000.00	72,050.12	15,000.00
Florida.....	374,966.06	14,999.95	74,996.06	14,999.87
Georgia.....	374,981.55	15,000.00	74,720.50	14,720.50
Idaho.....	299,824.13	15,000.00	70,842.22	15,000.00
Illinois.....	374,564.95	14,564.95	74,851.62	14,987.24
Indiana.....	374,901.19	15,000.00	70,000.00	15,000.00
Iowa.....	375,000.00	15,000.00	75,000.00	15,000.00
Kansas.....	375,000.00	15,000.00	75,000.00	15,000.00
Kentucky.....	374,996.57	15,000.00	75,000.00	15,000.00
Louisiana.....	375,000.00	15,000.00	75,000.00	15,000.00
Maine.....	374,999.62	15,000.00	75,000.00	15,000.00
Maryland.....	374,967.40	15,000.00	74,763.99	15,000.00
Massachusetts.....	374,617.70	15,000.00	75,000.00	15,000.00
Michigan.....	374,676.10	15,000.00	71,341.20	15,000.00
Minnesota.....	375,000.00	15,000.00	74,345.74	15,000.00
Mississippi.....	375,000.00	15,000.00	75,000.00	15,000.00
Missouri.....	370,097.24	15,000.00	75,000.00	15,000.00
Montana.....	285,000.00	15,000.00	72,417.04	15,000.00
Nebraska.....	374,932.16	15,000.00	75,000.00	15,000.00
Nevada.....	374,939.32	15,000.00	74,663.58	15,000.00
New Hampshire.....	375,000.00	15,000.00	75,000.00	15,000.00
New Jersey.....	374,961.97	15,000.00	74,558.78	15,000.00
New Mexico.....	339,998.90	15,000.00	75,000.00	15,000.00
New York.....	374,860.54	15,000.00	74,880.85	15,000.00
North Carolina.....	375,000.00	15,000.00	75,000.00	15,000.00
North Dakota.....	316,778.34	15,000.00	75,000.00	15,000.00
Ohio.....	375,000.00	15,000.00	73,514.02	15,000.00
Oklahoma.....	314,270.80	15,000.00	69,324.74	15,000.00
Oregon.....	360,156.64	15,000.00	70,000.00	15,000.00
Pennsylvania.....	374,967.43	15,000.00	74,995.41	15,000.00
Rhode Island.....	375,000.00	15,000.00	72,464.20	15,000.00
South Carolina.....	374,542.15	15,000.00	73,460.12	15,000.00
South Dakota.....	318,250.00	15,000.00	70,000.00	15,000.00
Tennessee.....	375,000.00	15,000.00	75,000.00	15,000.00
Texas.....	375,000.00	15,000.00	72,592.26	14,715.35
Utah.....	240,000.00	15,000.00	74,821.94	15,000.00
Vermont.....	375,000.00	15,000.00	75,000.00	15,000.00
Virginia.....	372,829.48	14,987.90	74,949.86	14,997.81
Washington.....	314,726.75	15,000.00	71,080.11	15,000.00
West Virginia.....	374,968.71	15,000.00	72,859.12	15,000.00
Wisconsin.....	375,000.00	15,000.00	75,000.00	15,000.00
Wyoming.....	360,000.00	15,000.00	75,000.00	15,000.00
Total.....	7,407,281.00	719,540.80	3,544,679.14	719,420.77



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